SERVICE MANUAL

PRICE $2.00
504
SERIAL NUMBERS
BEGINNING 10001

The Fisher®
504

Studio-Standard

2/4-Channel Convertible Stereo Receiver

WORLD LEADER IN HIGH QUALITY STEREO

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CAUTION: **This precision high-fidelity instrument should be serviced only by qualified personnel, trained in the repair of transistor equipment and printed circuitry.**

Many of these items are included only as a reminder — they are normal procedures for experienced technicians. Shortcuts may be taken, but these often cause additional damage to transistors, circuit components, or printed circuit boards.

SOLDERING: A well-tinned, hot, clean soldering iron tip will make soldering easier, without causing damage to the printed circuit board or the components mounted on it. Regular use of a sponge cleaner will maintain a clean soldering surface. The heat available at the tip, (not the wattage of the iron) is important. Some 50-watt irons reach temperatures of 1,000° F, while others will hardly melt solder. Small-diameter tips should be used for single solder connections, pyramid and chisel tips for large areas.

Always disconnect the AC power cord from the line when soldering. Turning the power switch OFF is not sufficient. Power-line leakage paths, through the heating elements of the iron, may destroy transistors.

PARTS REMOVAL: If a part is not being returned for in-warranty factory replacement, it may be cut in half (with diagonal cutting pliers) to make removal easier. Multiple terminal parts, such as IF transformers, or electrolytic capacitors, should be removed using special de-soldering tips made especially for this purpose. Removing solder from terminals, reduces the possibility of breaking the printed circuit board when the part is removed.

ACCIDENTAL SHORTS: A clean working area, free of metal particles, screws, etc., is an important preventive in avoiding servicing problems: Screws, removed from the chassis during servicing, should be stored in a box until needed. While a set is operating, it takes only an instant for a base-to-collector short to destroy a transistor (and others direct-coupled to it). In the time it takes for a dropped screw, washer, or screwdriver, to contact a pair of terminals (or terminal and chassis), a transistor can be ruined.

SOLID-STATE DEVICES: Integrated Circuits contain the equivalent of many circuit parts, including transistors, diodes, resistors, and capacitors. The preferred troubleshooting procedure requires isolating the trouble to one stage using AC signal tracing methods. Once the suspected stage is located the DC voltages at the input and output leads are measured to give an accurate indication of the operating conditions of the IC. DO NOT use an ohmmeter, to check continuity with the IC mounted on the printed circuit board. Forward biasing the internal junctions within the IC may burn out the transistors. Do not replace a defective IC until all external resistors, capacitors, and transformers are checked first, to prevent the replacement IC from failing immediately due to a defect in the connecting components. Solder and unsolder each lead separately using a pliers or other heat sink on the lead to prevent damage from excessive heat. Check that the leads are connected to the correct locations on the printed circuit board before turning the set on.

Whenever possible, a transistor tester should be used to determine the condition of a transistor or diode. Ohmmeter checks do not provide conclusive data, and many even destroy the junction(s) within the device.

Never attempt to repair a transistor power amplifier module until the power supply filter-capacitors are fully discharged.

If an output or driver transistor becomes defective (opens or shorts), always check ALL direct-coupled transistors and diodes in that channel. In addition, check the bias pot., and other parts in the bias network, before installing replacement transistors. All output and driver transistors in one channel may be destroyed if the bias network is defective. After parts replacement, check bias for specified idling current.

In some applications, replacement of transistors must be made from the same beta group as the original type. The beta group is indicated by a colored marking on the transistor. Include this information when ordering replacements.

When mounting a replacement power transistor, be sure the bottom of the flange, mica insulator, and the surface of the heat sink, are free of foreign matter. Dust and grit will prevent flat contact, reducing heat transfer to the heat sink. Metallic particles can puncture the insulator, cause a short, and destroy the transistor.

Silicone grease must be used between the transistor and the mica insulator and between the mica and the heat sink for best heat transfer. Use Dow-Corning DC-3, or an equivalent compound made for power transistor heat conduction.

Use care when making connections to speakers and output terminals. To reduce the possibility of shorts, lugs should be used on the exposed ends, or stranded wire should be tinned to prevent frayed wire ends. Current in the speakers and output circuitry is quite high — poor contacts, or small wire, can cause significant power losses. For wire lengths greater than 30 feet, 16 AWG, or heavier, should be used.

VOLTAGE MEASUREMENTS: All voltages are measured with the line voltage adjusted to 120 volts. All measured voltages are ± 20%. DC voltages are measured to chassis with a VTVM, with no signal input unless otherwise noted. AC signal voltages are measured under the conditions specified on the schematic.

ALIGNMENT PROCEDURES: DO NOT attempt realignment unless the required test equipment is available, and the alignment procedure is thoroughly understood.

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TEST EQUIPMENT

The following equipment is required to completely test and align the 504 Receiver:

- Line Voltage Autotransformer or Voltage Regulator
- DC Vacuum Tube Voltohmmeter
- Accurately Calibrated AC Vacuum Tube Voltmeter
- Oscilloscope (Flat to 100 kHz Minimum)
- Low-Distortion Audio Sine-Wave Generator
- Harmonic Distortion Analyzer
- 4 Load Resistors, 4-Ohms, 250 Watts (Minimum Rating)
- Low-Distortion AM-FM Signal Generator
- 10.7 MHz Sweep Generator (Fisher 3024*)
- Multiplex Generator (Fisher 1536*)
- 455 kHz Sweep Generator (Fisher 3025*)
- Soldering Iron with Small Tip, Fully Insulated from AC Line
- Suction Desoldering Tool
- Sound Source and Speakers for Listening Tests

*Requires Power Supply (Fisher 1561)

PLEASE READ CAREFULLY: The parts list on this and following pages do not include shipping charges. Please include the serial number of the Fisher equipment for which the part(s) are intended. Send your order to:
PARTS DEPARTMENT, FISHER RADIO, 11-40 45th Road, Long Island City, N.Y. 11101

Symbol	Description	Part Number	Sug. Ret.
	PANEL		
--	Knob, TUNING	EK20042-1	1.05
--	Knob, MASTER BALANCE	EK20044	.45
--	Knob, Pushbutton	EK20030-3	.80
--	Knob, Slide	EK20043-1	.30
--	Knob, Rotary	EK20041-1	1.10
--	Dress Panel Assembly	AS4094-147	25.05
	Nameplate '504'	NP22653-1	.85
	Insert, Upper (Window)	AD23062-1	2.65
	Spring, Window Retainer	AN51427	.30
	Insert, Lower	AD23061-1	2.15
	Bushing, Pushbutton	EA51413	.30
	End Strip, Right	AD23065-3	1.45
	End Strip, Left	AD23065-4	1.45
--	Speed Nut, Dress Panel Retainer	HN24015-1	.30
CR505	L.E.D.-STEREOBEACON	TR19001	1.40
CR865, 866	L.E.D.-2/4 SPEAKERS (with mounting clip and retainer)	TR19003	2.05
--	Tuning Shaft/Bushing Assembly	AS20725	1.50
--	Dial Pointer	AP20507-1	.75
--	Dial Glass (Acrylic)	AS4094-162	2.80
I1, 2, 3, 4	Lamp, Dial	LM21434	1.00
I5, 6	Lamp, Meter	AS21410-6	.75
I8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18	Lamp - Mode, Selector, Display	LM21421-4	.70
M1	Signal Meter	MC21620	3.90
M2	Center-of-Ch Meter	MC21619EX	3.90
--	Mounting Pad, Meter	EM21126	.30
R124A, B	Control, MIDRANGE	RP50160-286	3.00
R132A, B, 133A, B, 138A, B, 139A, B	Control, FRONT/REAR BASS, FRONT/REAR TREBLE	RP50160-285	2.75
R297A, B, C, D	Control, MASTER BALANCE	RP50160-289	10.30
--	Bezel, MASTER BALANCE	EA4094-136	.40
R298A, B, C, D	Control, MASTER VOLUME	RP50160-287	7.10
S1	Switch, POWER	SP50200-65	2.95
S1	*Switch, POWER	SP50200-64	2.55
S11	Switch, SELECTOR	SR4094-150	7.50
S81	Switch, MODE/MONITOR	SR4094-154	6.75
S275, 276, 277, 278	4-Switch Assembly, SQ DECODER, REDUCED VOLUME, FM MUTING OFF, FM NOISE FILTER	SP50200-60	3.45
S283, 284, 285, 286	4-Switch Assembly, LOW FILTER, LOUDNESS, HIGH FILTER, AM DNL	SP50200-59	3.45
S865	Switch, AUDIO DISPLAY	SP50200-62	.95
S866	Switch, SPEAKERS	SR4094-151	7.95
--	Jack, TO RCDR, PHONES	JK20627-5	1.10
	CHASSIS-REAR		
--	Terminal Strip, Antenna	ET51329	.85
--	Terminal Strip, Speakers	ET51340-1	5.10
--	Connector, Single Jack Female	J50465	.40
--	Connector, 22 Jack Female	JK20696	5.90
--	Cover, Output Transistor	AM2155-113	.85
J1	AC Outlet	JK20665	.60
--	Line Cord	W50023-1	1.20
--	Strain Relief	EM21116-7	.30
--	Fuse Holder	EA51408	.95
--	*Line Cord (3-Conductor)	WR20678	3.20
--	*Strain Relief	E51A110	.25
S2	*Switch, Fused Voltage Selector	SR51304-1	1.90
	BOARDS		
--	PCB, AM-FM Tuner	PB2301-1	77.60
--	*PCB, AM-FM Tuner	PB2301-2	77.50
--	PCB, AM Dynamic Noise Limiter	PB2310-1	3.30
--	PCB, Preamplifier	PB2303-1	8.00
--	PCB, Control Amplifier	PB2304-1	41.30
--	PCB, SQ Decoder	PB2302-1	21.05
--	PCB, Switch Board	PB2323-1	6.35
--	PCB, Switch Board	PB2322-1	9.25
--	PM, Power Amplifier Module	PM2155-2	91.15
	PCB, Predriver (p/o PA)	PB2306-2	38.85
--	PCB, Audio Display	PB2320-1	6.00
--	PCB, Phones	PB2315-1	2.10
--	PCB, Power Supply	PB2305-1	26.05
--	*PCB, Power Supply	PB2305-2	26.55
--	PCB, Mode Lamp Board	PB2326-1	2.15
--	PCB, Dial Lamp Board	PB2316-1	6.45
--	PCB, Selector Lamp Board	PB2328-1	2.50
--	PCB, Display Lamp Board	PB2327-1	2.50
	MISCELLANEOUS		
--	Cabinet Assembly	AS4094-155	49.10
	Cabinet (only)	KK4094-148	33.60
	Grille, Cabinet	EA51406	.90
	Foot, Plastic	E51A172	.30
	Cover, Bottom	AA4094-119	7.95
	Mounting Pad, Cover	EM51293	.30
T1	Transformer, Power	TD4094-115	36.70
T1	*Transformer, Power	TE4094-215	41.15
L300	Antenna, AM Ferrite	AS4094-160	2.95
--	Bracket, AM Antenna Support	EA24006	1.20
--	Dial Drum Assembly	AS4094-166	.95
--	Connector, 12-Pin Male-Male	HH20686-12	.95
--	Coupling, Extension Shaft	H50A799	.35

*Used in Export Units

PRICES SUBJECT TO CHANGE WITHOUT NOTICE

MECHANICAL DISASSEMBLY

REMOVING CABINET

(1) Unplug AC power cord.
(2) Remove the ten retaining screws from the underside of cabinet.
(3) Slide cabinet off rear of chassis.

REPLACING DIAL LAMPS

(1) Unplug AC power cord and remove cabinet.
(2) Disconnect the two leads between the dial lamp board and terminal strip below the board. (It is unnecessary to disconnect meter lamp leads.)
(3) Remove dial lamp board mounting screws and tilt out board.
(4) Snap replacement lamps in holders and position the lamps so that the clear surface of each lamp faces the dial glass.

REPLACING METER LAMP ASSEMBLIES

(1) Unplug AC power cord and remove cabinet.
(2) Unsolder the meter lamp leads from the dial lamp board.
(3) Squeeze long sides of the lamp assembly together and pull out.
(4) Snap replacement lamp assembly into cutout and reconnect leads.

REPLACING MODE, SELECTOR, AND DISPLAY LAMPS

(1) Unplug AC power cord and remove cabinet.
(2) Label and disconnect leads from the appropriate lamp board.
(3) Spread top and bottom of lamp housing apart to release board.
(4) Remove old lamp and solder replacement lamp on board.

REMOVING DRESS PANEL

(1) Unplug AC power cord and remove cabinet.
(2) Gently pull all knobs from their shafts *except* the push-button knobs and the MASTER BALANCE knob. (These knobs need not be removed.)
(3) Label and disconnect the leads of the Light Emitting Diodes located above the SPEAKERS switch. (Failure to observe proper polarity will destroy the LED's when reconnected.)
(4) Remove the six flat-head screws holding the dress panel to the chassis (2 on top, 4 on bottom). Remove panel.

REMOVING DIAL GLASS AND METERS

(1) Remove cabinet and dress panel.
(2) Remove pointer from rail. (It is unnecessary to separate pointer from dial cord.)
(3) Remove the nine round-head phillips screws from the front and top dial glass retainers (6 on front, 3 on top). Remove the retainers.
(4) Label and disconnect LED and meter wires to permit the dial glass (with meters attached) to be removed.
(5) Remove meters from the dial glass as follows:
  (a) Remove tape holding light hood to meter and remove hood.
  (b) Gently pry meter from dial glass. Avoid scratching the black-out finish on the dial glass with sharp or pointed instruments.
  (c) Peel off residual adhesive from dial glass.

REMOVING PC BOARDS

Remove the cabinet for access to boards. Label and remove interconnecting leads. Most boards come out by removing the screws that secure the board to the chassis. Some boards require different or additional procedures for removal:

POWER SUPPLY

Remove the mounting screws and the four screws on the outside of the chassis which hold the heat sink to the chassis.

SQ DECODER

Displace the couplings that secure the two extender shafts of the SPEAKERS and MODE/MONITOR switches. The extender shafts tilt upward sufficiently to allow the board to be removed.

PREAMPLIFIER

Take out the board (with mounting brackets attached) by removing the two screws on the *outside* of the chassis.

SWITCH BOARDS

Remove the dress panel for access to mounting screws.

CONTROL AMPLIFIER

Remove the dress panel for access to the four hex mounting screws which hold the slide control/circuit board assembly to the front panel. Remove the module from the bottom of the chassis.

REMOVING TUNING SHAFT ASSEMBLY

(1) Remove cabinet and dress panel.
(2) Remove dial glass and dial cord.
(3) Rotate flywheel to align set-screw with hole on top. Loosen set-screw and remove flywheel.
(4) Remove lock-nut and washer from shaft and remove the tuning shaft/bushing assembly.

CAUTION:
(A) Limit tests to 10 minutes.
(B) Use load resistors with minimum power ratings of 250 watts each.

Unplug AC power cord. Depress AUDIO DISPLAY push-button, release all others. Set TONE CONTROLS, and MASTER BALANCE control to center positions. Set SPEAKERS switch to MAIN-4, MODE/MONITOR switch to 4-CH, and SELECTOR switch to AUX1.

ONE CHANNEL DRIVEN

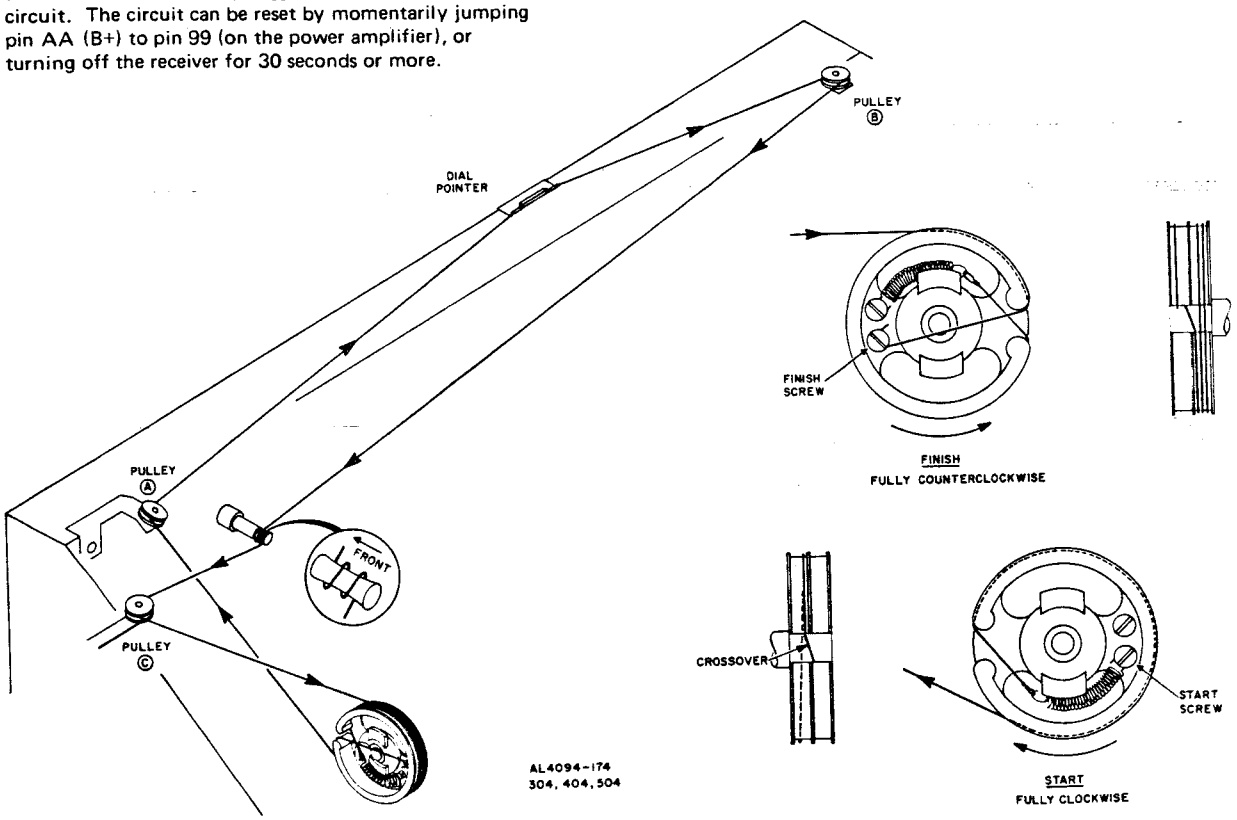
(1) Connect a low-distortion sine wave generator to AUX 1 IN FRONT LEFT jack. Set generator frequency to 1kHz, and output to minimum.
(2) Connect a 4-ohm load resistor between MAIN SPEAKERS FRONT LEFT and COM terminals. Connect a Harmonic Distortion analyzer across the load.
(3) Connect AC power cord and depress POWER pushbutton. Slide MASTER VOLUME to MAX.
(4) Increase generator output for 52 watts RMS (14.4V across 4-ohm load). HD meter should indicate 0.5% or less.
(5) Repeat preceding steps for FRONT RIGHT, REAR LEFT, and REAR RIGHT channels.

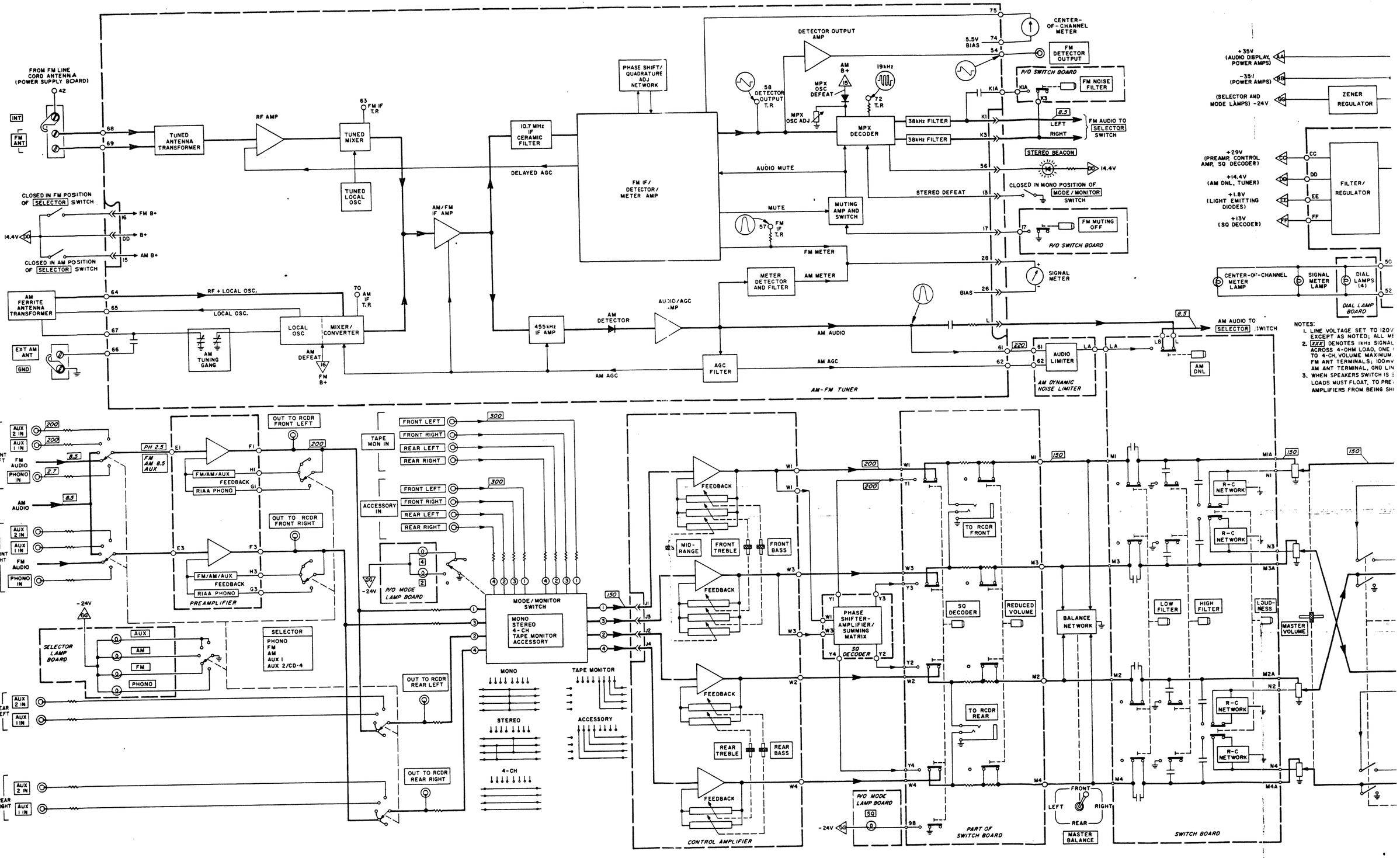
ALL CHANNELS DRIVEN

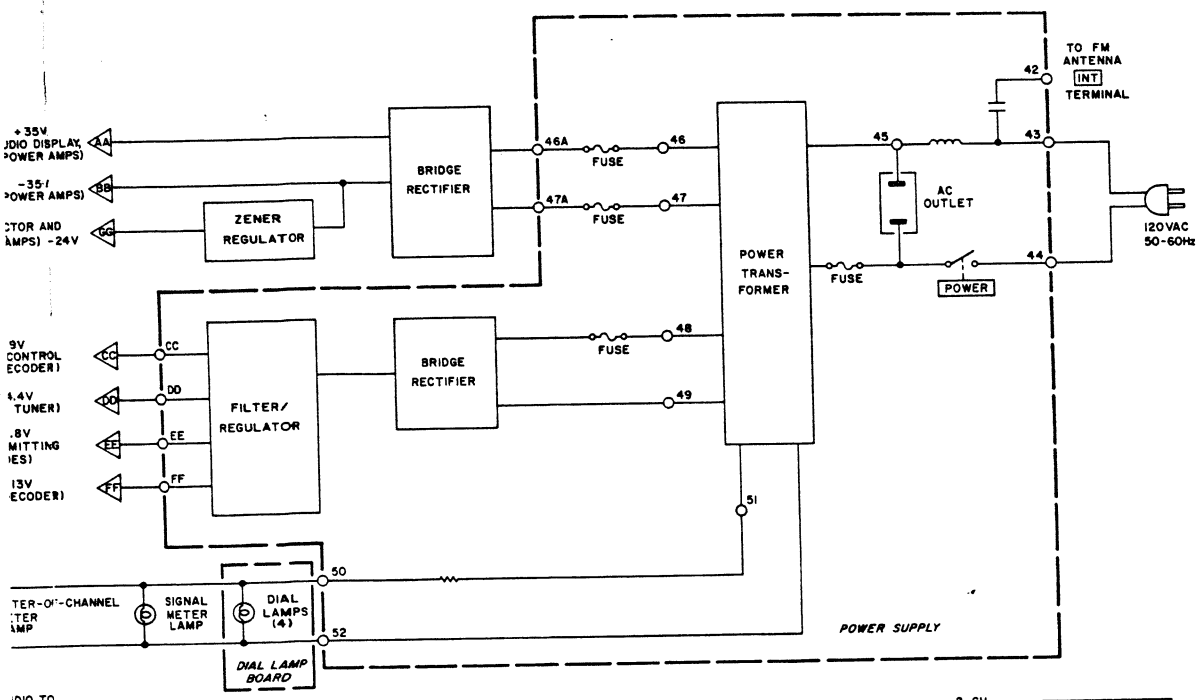
Connect a 4-ohm load across each of the four MAIN SPEAKERS output terminals. Set the MODE/MONITOR switch to MONO and check for distortion of 0.5% or less at 52 watts on each channel with all channels driven simultaneously.

CAUTION: When amplifiers are switched for 2-channel operation, inspect load connections carefully before testing or troubleshooting. Front-channel amplifier loads must be 'floating' (ungrounded). If any of the front-channel speakers COM terminals are grounded through common load returns, or through test equipment grounds connected to the load, the output of each series-connected rear amplifier will be short-circuited. This may trigger the auto shutdown circuit. The circuit can be reset by momentarily jumping pin AA (B+) to pin 99 (on the power amplifier), or turning off the receiver for 30 seconds or more.

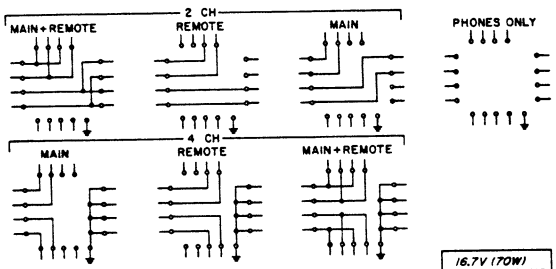
(1) Remove cabinet and dress panel.
(2) Remove dial pointer from old dial cord.
(3) Rotate tuning capacitor drum fully clockwise. Loosen machine screws in drum and remove old cord.
(4) Tie new dial cord to end of spring. Fasten spring to START screw. See illustration.
(5) Run cord through slot in rim, then cross the cord to inside of drum and wrap one full turn clockwise around the drum. Guide cord around pulleys 'A' and 'B' and wrap two full turns (clockwise viewed from back) around tuning shaft.
(6) Rotate drum fully counterclockwise allowing cord to wind on drum.
(7) Guide cord around pulley 'C', over the top (outside) of the drum, and into the rim slot.
(8) Wrap the cord around the FINISH screw. Pull cord taut and tighten screw. Turn tuning shaft clockwise and counterclockwise several times to distribute tensioning.
(9) Place pointer on rail and slip cord over tabs. Turn tuning shaft fully counterclockwise, slide pointer to (0) mark on logging scale, and cement to cord.
(10) Check dial calibration. Refer to TUNER ALIGNMENT, page 8.

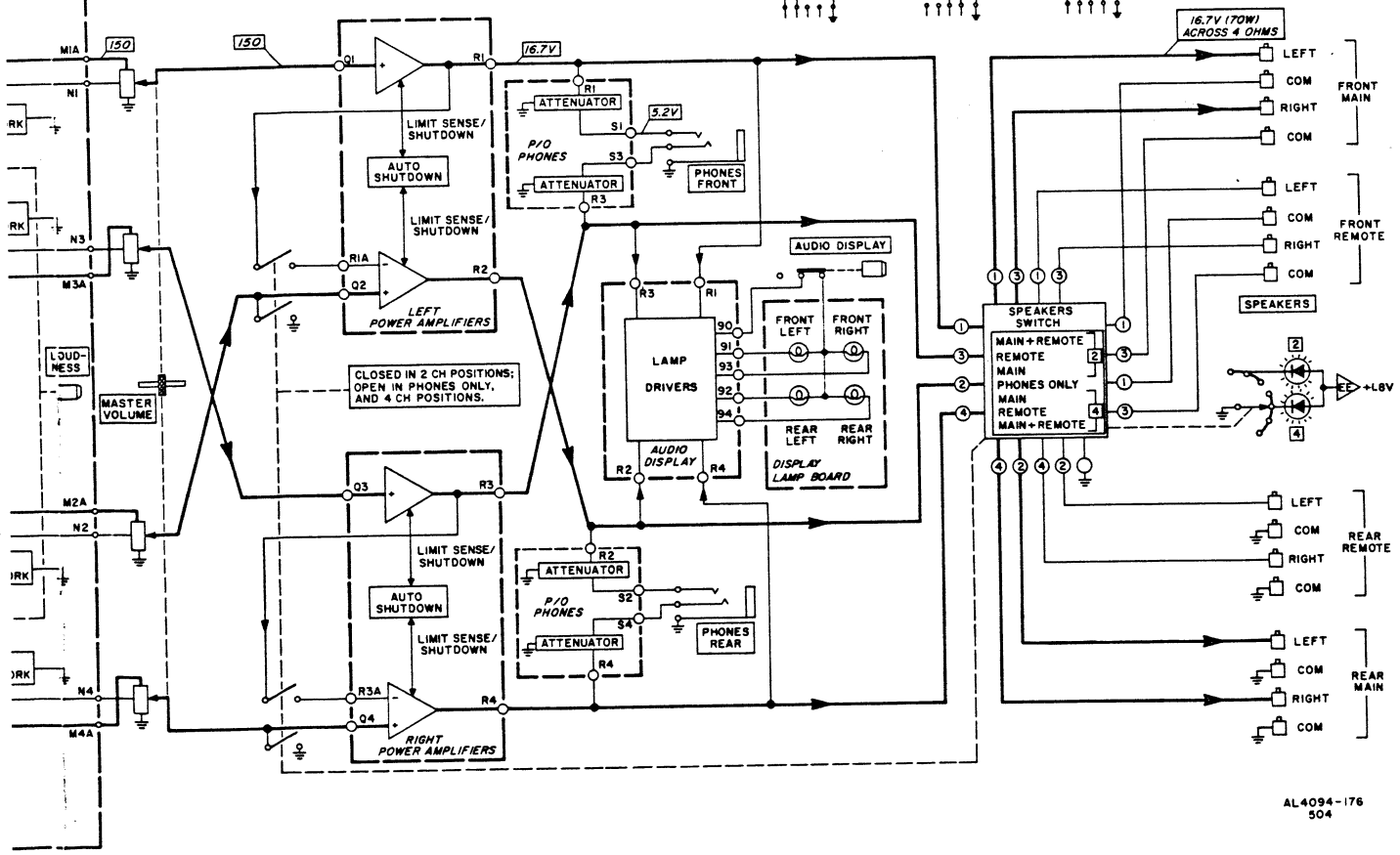



FROM FM LINE CORD ANTENNA (POWER SUPPLY BOARD)
42
INT
FM ANT
68
69
TUNED ANTENNA TRANSFORMER
RF AMP
63 FM IF T.P.
TUNED MIXER
TUNED LOCAL OSC
DELAYED AGC
10.7 MHz IF CERAMIC FILTER
PHASE SHIFT/ QUADRATURE ADJ NETWORK
FM IF/ DETECTOR/ METER AMP
DETECTOR OUTPUT AMP
58 DETECTOR OUTPUT T.P.
MPX OSC DEFEAT
MPX OSC ADJ
AM B+
19kHz
72 T.P.
MPX DECODER
38kHz FILTER
38kHz FILTER
75
CENTER-OF-CHANNEL METER
5.5V BIAS
74
54
FM DETECTOR OUTPUT
P/O SWITCH BOARD
FM NOISE FILTER
K1A
K3
8.5
LEFT
RIGHT
FM AUDIO TO SELECTOR SWITCH
STEREO BEACON
14.4V
56
AUDIO MUTE
STEREO DEFEAT
13
CLOSED IN MONO POSITION OF MODE/MONITOR SWITCH
MUTE
57 FM IF T.P.
MUTING AMP AND SWITCH
17
FM MUTING OFF
P/O SWITCH BOARD
FM METER
28
SIGNAL METER
AM METER
METER DETECTOR AND FILTER
BIAS
26
CLOSED IN FM POSITION OF SELECTOR SWITCH
16
FM B+
14.4V
DD
B+
CLOSED IN AM POSITION OF SELECTOR SWITCH
15
AM B+
AM FERRITE ANTENNA TRANSFORMER
64
65
RF + LOCAL OSC.
LOCAL OSC.
70 AM IF T.P.
67
66
EXT AM ANT
GND
AM TUNING GANG
LOCAL OSC
MIXER/ CONVERTER
AM DEFEAT
16
FM B+
AM/FM IF AMP
455kHz IF AMP
AM DETECTOR
AUDIO/AGC AMP
AM AUDIO
AM AGC
AGC FILTER
AM AGC
AM-FM TUNER
61
62
220
AUDIO LIMITER
AM DYNAMIC NOISE LIMITER
LA
LB
L
8.5
AM AUDIO TO SELECTOR SWITCH
AM DNL
+35V (AUDIO DISPLAY, POWER AMPS)
AA
-35V (POWER AMPS)
BB
(SELECTOR AND MODE LAMPS) -24V
GG
ZENER REGULATOR
+29V (PREAMP, CONTROL AMP, SQ DECODER)
CC
+14.4V (AM DNL, TUNER)
DD
+1.8V (LIGHT EMITTING DIODES)
EE
+13V (SQ DECODER)
FF
FILTER/ REGULATOR
CENTER-OF-CHANNEL METER LAMP
SIGNAL METER LAMP
DIAL LAMPS (4)
50
52
DIAL LAMP BOARD
NOTES:
1. LINE VOLTAGE SET TO 120V
EXCEPT AS NOTED; ALL ME
2. XXX DENOTES 1kHz SIGNAL
ACROSS 4-OHM LOAD, ONE
TO 4-CH, VOLUME MAXIMUM.
FM ANT TERMINALS; 100mV
AM ANT TERMINAL, GND LIN
3. WHEN SPEAKERS SWITCH IS
LOADS MUST FLOAT, TO PRE
AMPLIFIERS FROM BEING SH
FRONT LEFT
AUX 2 IN
AUX 1 IN
FM AUDIO
PHONO IN
200
8.5
2.7
AM AUDIO
FRONT RIGHT
REAR LEFT
REAR RIGHT
PH 2.5
FM AM 8.5 AUX
E1
E3
F1
F3
FM/AM/AUX
FEEDBACK
RIAA PHONO
H1
H3
G1
G3
PREAMPLIFIER
OUT TO RCDR FRONT LEFT
OUT TO RCDR FRONT RIGHT
OUT TO RCDR REAR LEFT
OUT TO RCDR REAR RIGHT
-24V
GG
P/O MODE LAMP BOARD
SELECTOR LAMP BOARD
AUX
AM
FM
PHONO
SELECTOR
PHONO
FM
AM
AUX 1
AUX 2/CD-4
TAPE MON IN
ACCESSORY IN
FRONT LEFT
FRONT RIGHT
REAR LEFT
REAR RIGHT
300
MODE/ MONITOR SWITCH
MONO
STEREO
4-CH
TAPE MONITOR
ACCESSORY
150
J1
J3
J2
J4
MONO
STEREO
4-CH
TAPE MONITOR
ACCESSORY
W1
W3
W2
W4
Y1
Y3
Y2
Y4
200
MID-RANGE
FRONT TREBLE
FRONT BASS
REAR TREBLE
REAR BASS
PHASE SHIFTER-AMPLIFIER/ SUMMING MATRIX
SQ DECODER
TO RCDR FRONT
TO RCDR REAR
REDUCED VOLUME
BALANCE NETWORK
LOW FILTER
HIGH FILTER
LOUDNESS
MASTER VOLUME
R-C NETWORK
M1
M1A
M3
M3A
M2
M2A
M4
M4A
N1
N3
N2
N4
98
P/O MODE LAMP BOARD
SQ
FRONT
LEFT
RIGHT
REAR
MASTER BALANCE
CONTROL AMPLIFIER
PART OF SWITCH BOARD
SWITCH BOARD



NOTES:
1. LINE VOLTAGE SET TO 120VAC FOR ALL VOLTAGE MEASUREMENTS. EXCEPT AS NOTED; ALL MEASUREMENTS ±20%.
2. XXX DENOTES 1kHz SIGNAL LEVELS (IN MILLIVOLTS) FOR 16.7V OUTPUT ACROSS 4-OHM LOAD, ONE CHANNEL DRIVEN, CONTROLS AND SWITCHES TO 4-CH, VOLUME MAXIMUM. 10mV FM, 1kHz AUDIO ±15kHz DEVIATION AT FM ANT TERMINALS; 100mV AM 1kHz AUDIO 22% MODULATION AT EXT AM ANT TERMINAL, GND LINK OPEN.
3. WHEN SPEAKERS SWITCH IS SET FOR 2-CH OPERATION, FRONT-CHANNEL LOADS MUST FLOAT, TO PREVENT SERIES-CONNECTED REAR AMPLIFIERS FROM BEING SHORT-CIRCUITED.





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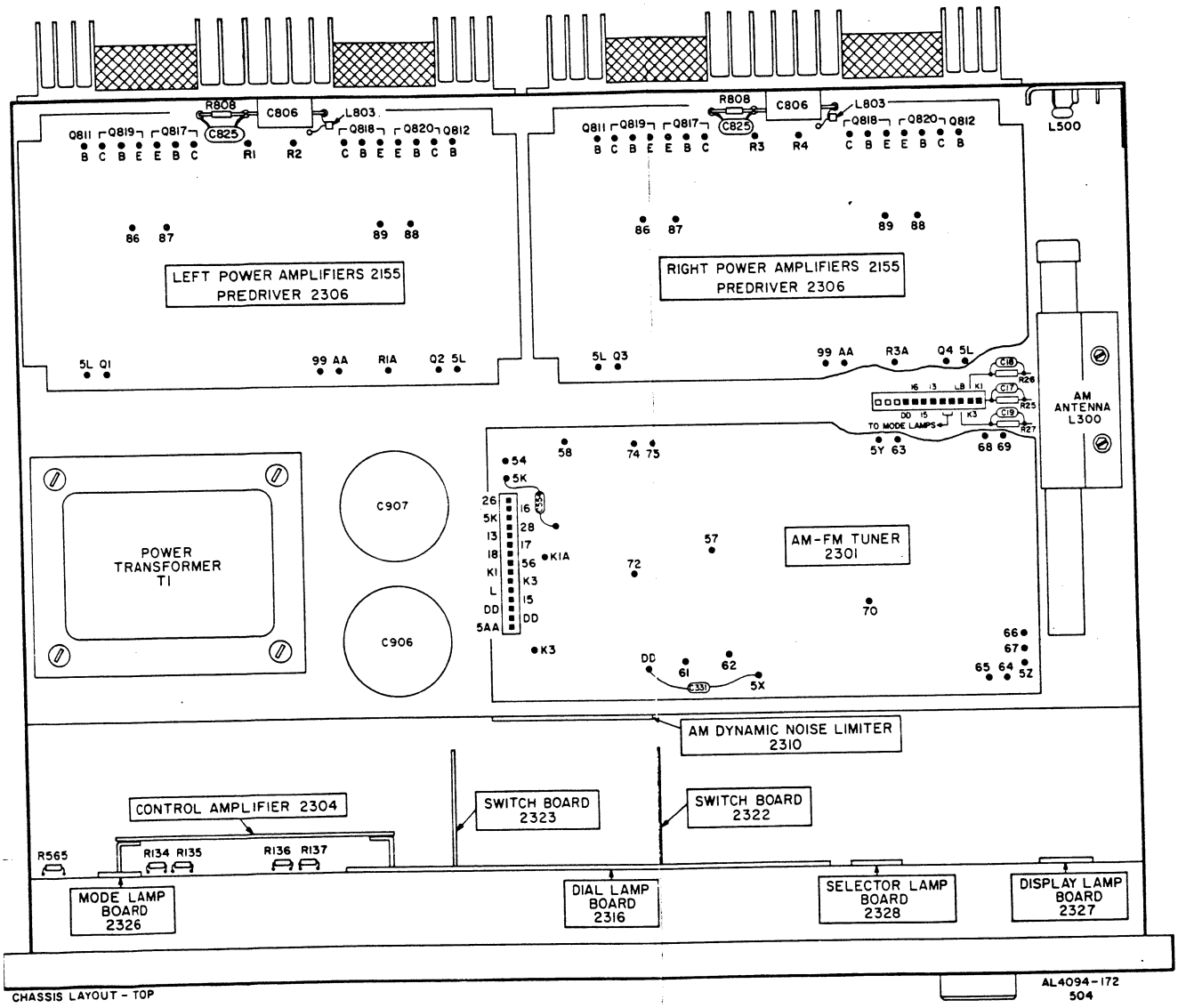
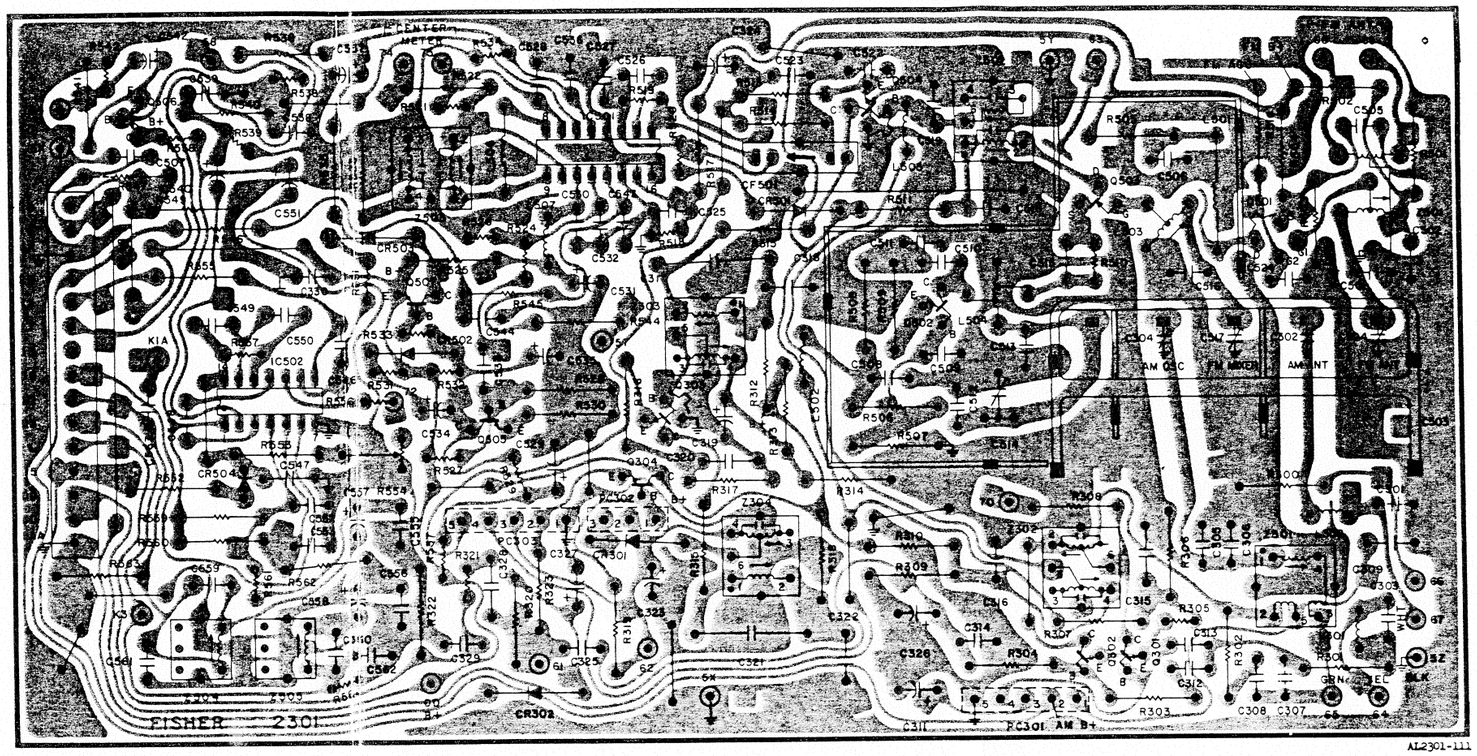


CHASSIS LAYOUT - TOP

AL4094-172
504

Symbol	Description	Part Number	Sug. Ret.
C301, 501, 516	Ceramic, 5pF, 5%, N750, 50V	CK22344-35	.30
C302	p/o C503	-	-
C303	Ceramic, 39pF, N330, 50V	CK22344-22	.30
C304	p/o C503	-	-
C305	Ceramic, 4pF, ±0.25pF, N750, 50V	CK22346-8	.30
C306	Ceramic, 15pF, 5%, N750, 50V	CK22344-2	.30
C308	Ceramic, 270pF, 10%, 50V	CK22350-5	.30
C309, 318, 322	Mylar, 0.1UF, 10%, 160V	C50B646-4	.45
C311, 316, 323, 326, 529	Electrolytic, 47UF, 16V	CE22342-8	.40
C312, 313, 314, 330, 523, 524, 527, 532	Ceramic, 0.02UF, +80-20%, 50V	CK22354-2	.30
C315	Mylar, 0.022UF, 10%, 160V	C50B647-9	.40
C317, 321	Polystyrene, 2200pF, 5%, 33V	C51B256-30	.45
C319, 327	Electrolytic, 10UF, 50V	CE22342-4	.35
C320	Ceramic, 0.1UF, +80-20%, 50V	CK22354-3	.35
C324	Electrolytic, 22UF, 35V	CE22342-6	.40
C328	Ceramic, 0.02UF, 20%, 50V	CK22349-3	.30
C331, 549	Mylar, 0.47UF, 10%, 50V	CY22356-13	.75
C502, 505, 507, 508, 515, 518, 526, 528, 530, 536, 544	Ceramic, 0.01UF, +80-20%, 50V	CK22354-1	.30
C503A, B, C, D, E	Tuning Gang Assembly	CV21013	5.70
C504	p/o C503	-	-
C506, 509, 522, 525, 539, 543	Ceramic, 1000pF, 10%, 50V	CK22350-12	.30
C510	Ceramic, 12pF, 5%, NPO, 50V	CK22344-6	.30
C511	Ceramic, 8pF, 5%, NPO, 50V	CK22344-5	.30
C513	Ceramic, 5pF, ±0.25pF, N1500	CT22336-10	.40
C514	Trimmer, 1-6pF	C50B938-5	.75
C517	p/o C503	-	-
C519	Silvered Mica, 330pF, 5%, 50V	CA22313-6	.45
C531, 535, 540, 542	Electrolytic, 4.7UF, 50V	CE22342-3	.35
C533	Ceramic, 0.1UF, +80-20%, 12V	CK22315-2	.50
C534, 537	Electrolytic, 1UF, 50V	CE22342-2	.35
C538	Ceramic, 220pF, 10%, 50V	CK22350-4	.30
C546, 550	Mylar, 0.22UF, 10%, 50V	CY22356-12	.60
C547	Silvered Mica, 470pF, 5%, 50V	CA22313-1	.45
C548	Ceramic, 0.05UF, +80-20%, 16V	CK22315-1	.50
C551	Electrolytic, 100UF, 16V	CE22342-12	.40
C552, 553	Mylar, 0.015UF, 5%, 50V	CY22356-5	.50
	*Mylar, 0.01UF, 5%, 50V	CY22356-4	.45
C554	Ceramic, 1000pF, 10%, 50V	CK22358-12	.30
C557, 558	Electrolytic, 0.47UF, 50V	CE22342-1	.35
C559, 560	Silvered Mica, 330pF, 1%, 50V	CA22313-31	.60
C563	Ceramic, 3300pF, 20%, 50V	CK22349-5	.30
CF501	Filter, 10.7MHz Ceramic	ZK22110	4.20
CR301	Diode, Germanium (AA119)	TR12001-4	.50
CR302, 501, 502, 503, 504	Diode, Silicon	TR13006-2	.35
CR505	Light Emitting Diode	TR19001	1.40
IC501	I.C., FM IF	TR09018	6.65
IC502	I.C., MPX Demodulator	TR09019	11.25
L300	Antenna, AM Ferrite	AS4094-160	2.95
L301, 302, 500, 502, 507	Choke, 3.3UH	LC21814-2	.35
L501	Choke, 1.2UH	LC21822-2	.50
L503	Coil, FM Mixer	L21B811	.75
L504	Coil, FM Oscillator	LC21816	.90
L505	Choke, 10UH	L50B848-6	.50
L506	Choke, 22UH	L50B848-18	.65
M1	Signal Meter	MC21620	3.90

Symbol	Description	Part Number	Sug. Ret.
C301, 501, 516	Ceramic, 5pF, 5%, N750, 50V	CK22344-35	.30
C302	p/o C503	-	-
C303	Ceramic, 39pF, N330, 50V	CK22344-22	.30
C304	p/o C503	-	-
C305	Ceramic, 4pF, ±0.25pF, N750, 50V	CK22346-8	.30
C306	Ceramic, 15pF, 5%, N750, 50V	CK22344-2	.30
C308	Ceramic, 270pF, 10%, 50V	CK22350-5	.30
C309, 318, 322	Mylar, 0.1UF, 10%, 160V	C50B646-4	.45
C311, 316, 323, 326, 529	Electrolytic, 47UF, 16V	CE22342-8	.40
C312, 313, 314, 330, 523, 524, 527, 532	Ceramic, 0.02UF, +80-20%, 50V	CK22354-2	.30
C315	Mylar, 0.022UF, 10%, 160V	C50B647-9	.40
C317, 321	Polystyrene, 2200pF, 5%, 33V	C51B256-30	.45
C319, 327	Electrolytic, 10UF, 50V	CE22342-4	.35
C320	Ceramic, 0.1UF, +80-20%, 50V	CK22354-3	.35
C324	Electrolytic, 22UF, 35V	CE22342-6	.40
C328	Ceramic, 0.02UF, 20%, 50V	CK22349-3	.30
C331, 549	Mylar, 0.47UF, 10%, 50V	CY22356-13	.75
C502, 505, 507, 508, 515, 518, 526, 528, 530, 536, 544	Ceramic, 0.01UF, +80-20%, 50V	CK22354-1	.30
C503A, B, C, D, E	Tuning Gang Assembly	CV21013	5.70
C504	p/o C503	-	-
C506, 509, 522, 525, 539, 543	Ceramic, 1000pF, 10%, 50V	CK22350-12	.30
C510	Ceramic, 12pF, 5%, NPO, 50V	CK22344-6	.30
C511	Ceramic, 8pF, 5%, NPO, 50V	CK22344-5	.30
C513	Ceramic, 5pF, ±0.25pF, N1500	CT22336-10	.40
C514	Trimmer, 1-6pF	C50B938-5	.75
C517	p/o C503	-	-
C519	Silvered Mica, 330pF, 5%, 50V	CA22313-6	.45
C531, 535, 540, 542	Electrolytic, 4.7UF, 50V	CE22342-3	.35
C533	Ceramic, 0.1UF, +80-20%, 12V	CK22315-2	.50
C534, 537	Electrolytic, 1UF, 50V	CE22342-2	.35
C538	Ceramic, 220pF, 10%, 50V	CK22350-4	.30
C546, 550	Mylar, 0.22UF, 10%, 50V	CY22356-12	.60
C547	Silvered Mica, 470pF, 5%, 50V	CA22313-1	.45
C548	Ceramic, 0.05UF, +80-20%, 16V	CK22315-1	.50
C551	Electrolytic, 100UF, 16V	CE22342-12	.40
C552, 553	Mylar, 0.015UF, 5%, 50V	CY22356-5	.50
	*Mylar, 0.01UF, 5%, 50V	CY22356-4	.45
C554	Ceramic, 1000pF, 10%, 50V	CK22358-12	.30
C557, 558	Electrolytic, 0.47UF, 50V	CE22342-1	.35
C559, 560	Silvered Mica, 330pF, 1%, 50V	CA22313-31	.60
C563	Ceramic, 3300pF, 20%, 50V	CK22349-5	.30
CF501	Filter, 10.7MHz Ceramic	ZK22110	4.20
CR301	Diode, Germanium (AA119)	TR12001-4	.50
CR302, 501, 502, 503, 504	Diode, Silicon	TR13006-2	.35
CR505	Light Emitting Diode	TR19001	1.40
IC501	I.C., FM IF	TR09018	6.65
IC502	I.C., MPX Demodulator	TR09019	11.25
L300	Antenna, AM Ferrite	AS4094-160	2.95
L301, 302, 500, 502, 507	Choke, 3.3UH	LC21814-2	.35
L501	Choke, 1.2UH	LC21822-2	.50
L503	Coil, FM Mixer	L21B811	.75
L504	Coil, FM Oscillator	LC21816	.90
L505	Choke, 10UH	L50B848-6	.50
L506	Choke, 22UH	L50B848-18	.65
M1	Signal Meter	MC21620	3.90



AL2301-111

Symbol	Description	Part Number	Sug. Ret.
M2	Center-of-Ch Meter	MC21619EX	3.90
PC301	Encapsulated Bias Network	EP50187-86	.85
PC302	Encapsulated 455kHz Filter	PC50B187-62	.85
PC303	Encapsulated Bias/Audio Network	PC50B187-60	.80
Q301, 302	Transistor, NPN (A494/BF194)	TR01027	1.00
Q303	Transistor, NPN (BF199 or A473/BF173) or	TR01074 TR01026	1.00 1.15
Q304, 505, 506	Transistor, NPN (BC239C)	TR01014	.70
Q501	Transistor, Dual-Gate MOSFET	TR08004	1.45
Q502	Transistor, PNP (SPS871)	TR02012	.95
Q503	Transistor, N-Channel FET	TR06014	1.80
Q504	Transistor, NPN (BF198 or A467/BF167) or	TR01073 TR01042	1.00 1.40
Q507	Transistor, PNP (2N4250)	TR02020-2	.55
R300	330K	RF25DC334J	.30
R301	68	RF25DC680J	.30
R302, 314	1.5K	RF25DC152J	.30
R303	47	RF25DC470J	.30
R304, 559, 560	6.8K	RF25DC682J	.30
R305	5.6	RF25DC5R6J	.30
R306, 506	2.2K	RF25DC222J	.30
R307, 546	15K	RF25DC153J	.30
R308, 319, 517, 531, 532, 535, 544	100K	RF25DC104J	.30
R309, 514	820	RF25DC821J	.30

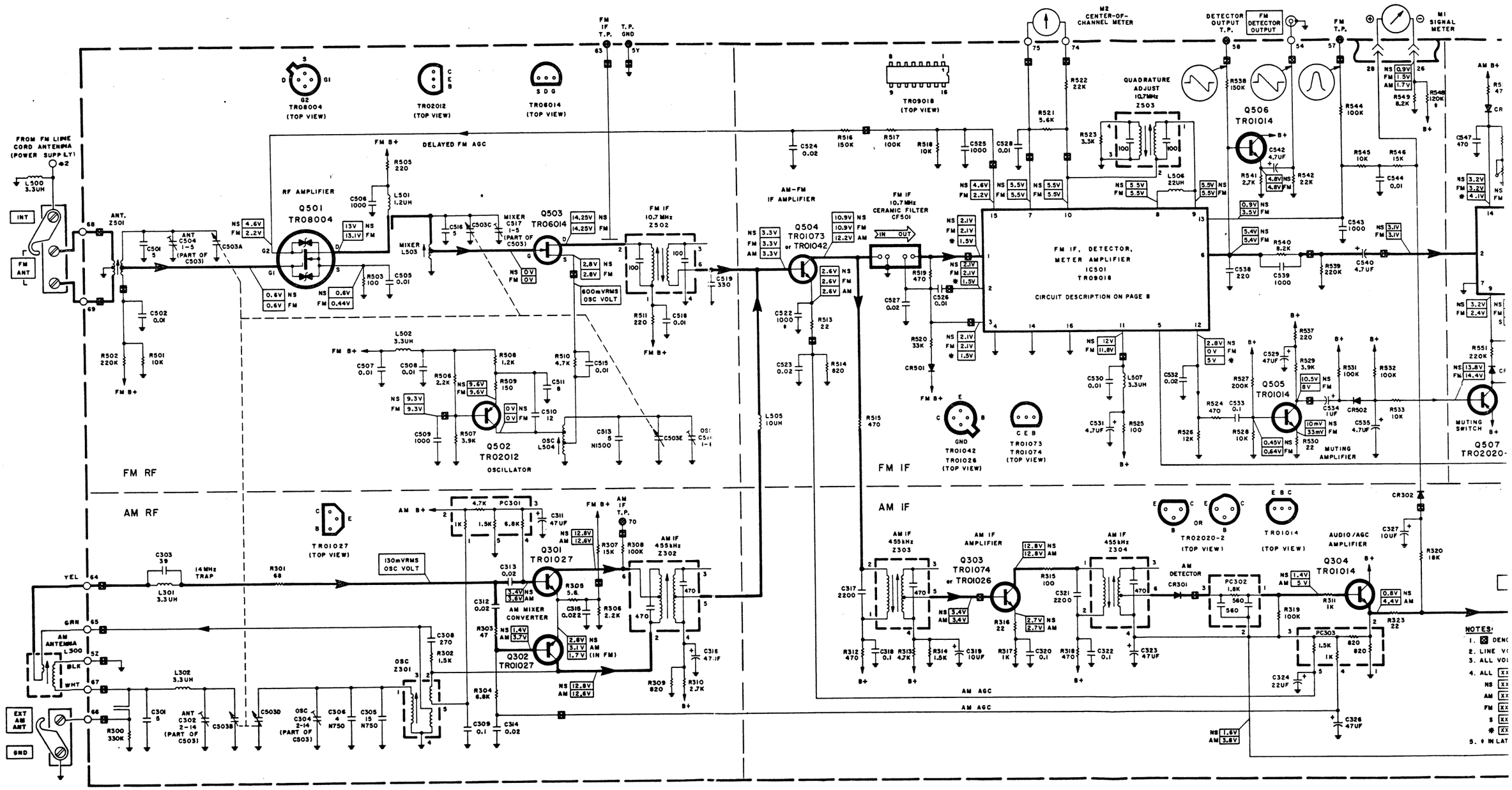
Symbol	Description	Part Number	Sug. Ret.
R310, 541	2.7K	RF25DC272J	.30
R311, 317, 536, 557	1K	RF25DC102J	.30
R312, 318	470	RF25DC471J	.30
R315, 519, 524			
R313, 510	4.7K	RF25DC472J	.30
R315, 503, 525	100	RF25DC101J	.30
R316, 323, 513, 530	22	RF25DC220J	.30
R320	18K	RF25DC183J	.30
R321	82K	RF25DC823J	.30
R501, 518, 528, 533, 545	10K	RF25DC103J	.30
R502, 539, 551	220K	RF25DC224J	.30
R505, 511, 537	220	RF25DC221J	.30
R507, 529	3.9K	RF25DC392J	.30
R508	1.2K	RF25DC122J	.30
R509	150	RF25DC151J	.30
R516, 538	150K	RF25DC154J	.30
R520	33K	RF25DC333J	.30
R521	5.6K	RF25DC562J	.30
R522, 542, 556, 561, 562	22K	RF25DC223J	.30

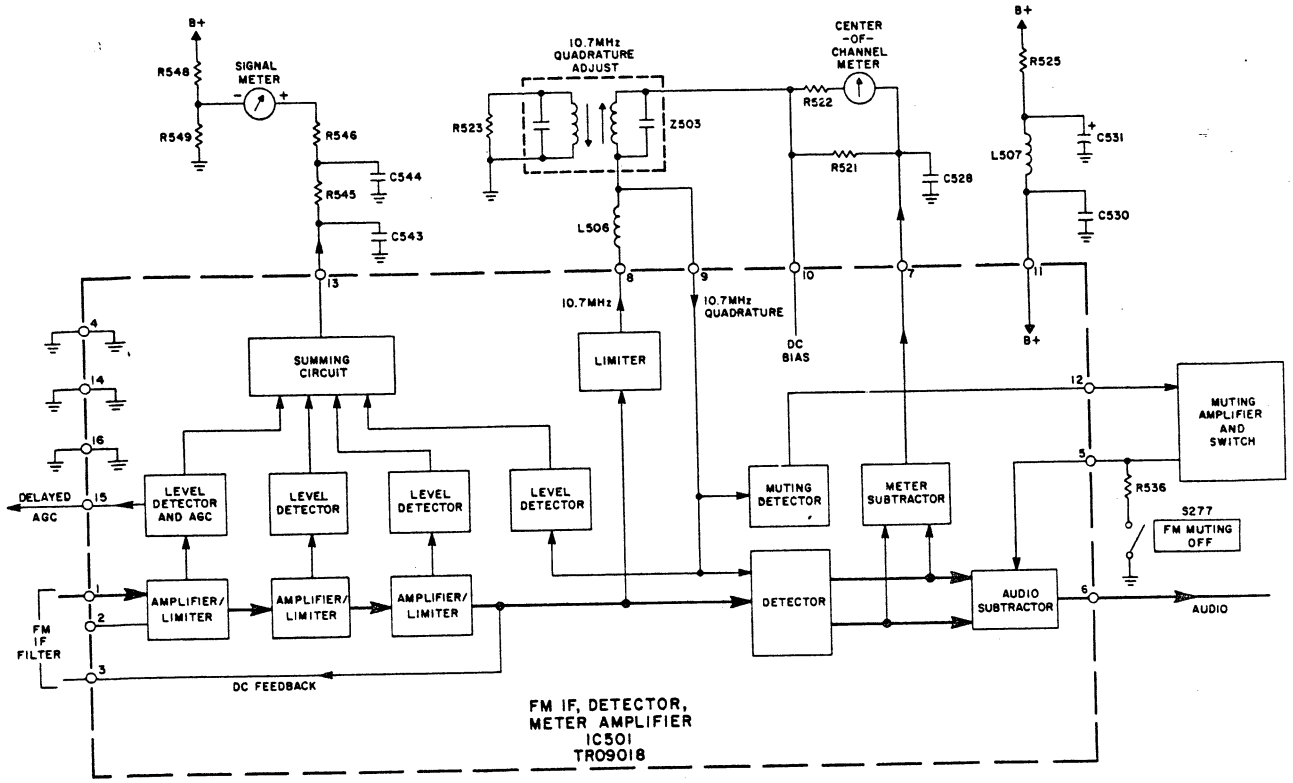
Symbol	Description	Part Number	Sug. Ret.
R523	3.3K	RF25DC332J	.30
R526	12K	RF25DC123J	.30
R527	200K	RF25DC204J	.30
R534	39K	RF25DC393J	.30
R540, 549	8.2K	RF25DC822J	.30
R548, 555	120K	RF25DC124J	.30
R552	47K	RF25DC473J	.30
R553	16K	RF25DC163J	.30
R554	Variable, 5K, 20%	RV50150-23-3	.60
R558	180	RF25DC181J	.30
R565	Composition, 680, ½W	RC20BF681J	.35
S277, 278	p/o 4-Switch Assembly	SP50200-60	3.45
Z301	Coil, AM Oscillator	ZZ50210-181	1.20
Z302	Transformer, 455kHz IF	ZZ50210-161	2.00
Z303	Transformer, 455kHz IF	ZZ50210-156	1.75
Z304	Transformer, 455kHz IF	ZZ50210-159	1.75
Z501	Coil, FM Antenna	L21B808	1.45
Z502	Transformer, 10.7MHz IF	ZZ50210-178	1.35
Z503	Transformer, 10.7MHz IF	ZZ50210-180	1.35
Z504, 505	Coil, 38kHz Trap	ZZ50210-169	.85
- -	Dial Drum Assembly	AS4094-166	.95
- -	Connector, 15-Pin Male	HH20685-15	.85
- -	Connector, 15-Pin Female	HH20683-15	.75

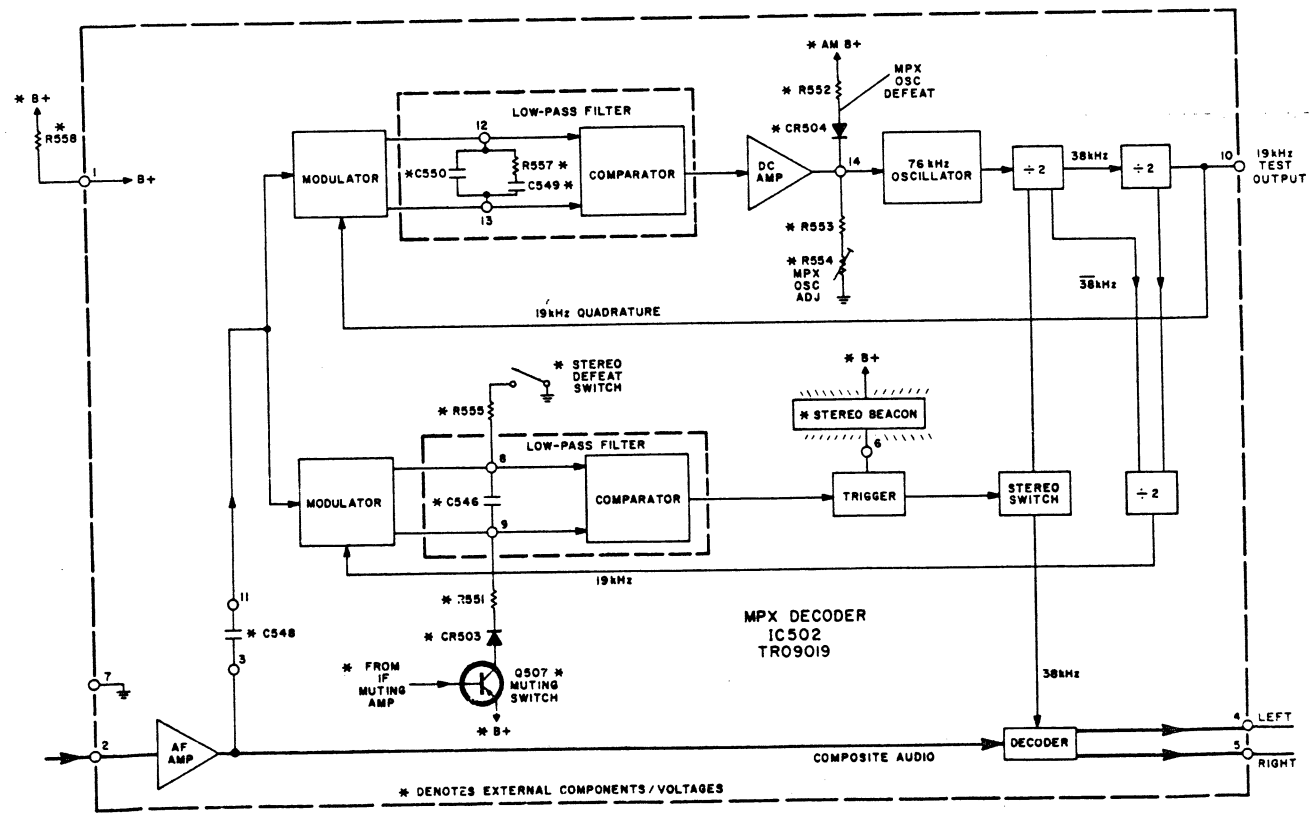
*Used in PB2301-2 Export Tuner

Except as noted, resistors are Deposited Film, 5%, ¼W. K=Kilohm

TUNER 2301-1


FM RF
AM RF
FM IF
AM IF
FROM FM LINE CORD ANTENNA (POWER SUPPLY)
INT
FM ANT
AM ANTENNA
EXT AM ANT
GND
RF AMPLIFIER Q501 TR08004
MIXER L503
Q503 TR06014
OSCILLATOR Q502 TR02012
AM MIXER CONVERTER Q301 TR01027
Q302 TR01027
OSC Z301
FM IF 10.7 MHz Z502
AM IF 455kHz Z302
AM IF 455kHz Z303
AM IF 455kHz Z304
AM-FM IF AMPLIFIER Q504 TR01073 or TR01042
FM IF 10.7MHz CERAMIC FILTER CF501
FM IF, DETECTOR, METER AMPLIFIER IC501 TR09018
CIRCUIT DESCRIPTION ON PAGE 8
AM IF AMPLIFIER Q303 TR01074 or TR01026
AM DETECTOR CR301
AUDIO/AGC AMPLIFIER Q304 TR01014
MUTING AMPLIFIER Q505 TR01014
Q506 TR01014
Q507 TR02020-
QUADRATURE ADJUST 10.7MHz Z503
M2 CENTER-OF-CHANNEL METER
M1 SIGNAL METER
DETECTOR OUTPUT T.P.
FM DETECTOR OUTPUT
FM T.P.
FM IF T.P.
AM IF T.P.
T.P. GND
DELAYED FM AGC
FM B+
AM B+
AM AGC
130mVRMS OSC VOLT
600mVRMS OSC VOLT
14 MHz TRAP
MUTING SWITCH
TR02012 (TOP VIEW)
TR06014 (TOP VIEW)
TR09018 (TOP VIEW)
TR01027 (TOP VIEW)
TR01042 TR01026 (TOP VIEW)
TR01073 TR01074 (TOP VIEW)
TR02020-2 (TOP VIEW)
TR01014 (TOP VIEW)
NOTES:


B+
R548
SIGNAL METER
R549
R546
R545
C544
C543
10.7MHz QUADRATURE ADJUST
R523
Z503
L506
CENTER -OF- CHANNEL METER
R522
R521
C528
B+
R525
L507
C531
C530
B+
10.7MHz
10.7MHz QUADRATURE
DC BIAS
SUMMING CIRCUIT
LIMITER
MUTING AMPLIFIER AND SWITCH
R536
S277
FM MUTING OFF
DELAYED AGC
LEVEL DETECTOR AND AGC
LEVEL DETECTOR
LEVEL DETECTOR
LEVEL DETECTOR
MUTING DETECTOR
METER SUBTRACTOR
AMPLIFIER/ LIMITER
AMPLIFIER/ LIMITER
AMPLIFIER/ LIMITER
DETECTOR
AUDIO SUBTRACTOR
AUDIO
FM IF FILTER
DC FEEDBACK
FM IF, DETECTOR, METER AMPLIFIER
IC501
TR09018


* B+
* R558
B+
* AM B+
* R552
MPX OSC DEFEAT
* CR504
LOW-PASS FILTER
MODULATOR
*C550
R557 *
C549 *
COMPARATOR
DC AMP
76 kHz OSCILLATOR
÷2
38kHz
÷2
19kHz TEST OUTPUT
* R553
* R554 MPX OSC ADJ
38kHz
19kHz QUADRATURE
* STEREO DEFEAT SWITCH
* R555
* B+
* STEREO BEACON
LOW-PASS FILTER
MODULATOR
* C546
COMPARATOR
TRIGGER
STEREO SWITCH
÷2
19kHz
* R551
* C548
* CR503
MPX DECODER
IC502
TR09019
* FROM IF MUTING AMP
Q507 * MUTING SWITCH
* B+
38kHz
AF AMP
COMPOSITE AUDIO
DECODER
LEFT
RIGHT
* DENOTES EXTERNAL COMPONENTS/VOLTAGES

TUNER IC DESCRIPTIONS

IF IC

The input from the IF filter is processed through three stages of amplification and limiting. The output of the third limiter is applied to a fourth limiter, and a balanced detector. The push-pull output from the detector is combined differentially in each of the two subtractor stages to produce separate outputs for the audio and the center-of-channel meter.

The output from the fourth limiter is applied through L506 to the tuned circuit consisting of Z503 and R523. At the exact center of the IF passband (nominally 10.7MHz), Z503 is preset to provide a 10.7MHz quadrature (90° out-of-phase) signal to the detector. The phase of the signal from the tuned circuit changes proportionally with changes in the frequency of the IF signal. With no audio modulation, the inputs to the detector are in quadrature and the outputs of the detector are balanced. No differential signals appear at the outputs of the subtractor stages. When the frequency of the IF signal deviates from 10.7MHz (as a result of audio modulation or station detuning), the detector outputs unbalance and differential DC signals appear at pins 6 and 7. The center-of-channel meter, which responds to DC unbalances of the detector does not respond to AC components.

The muting detector monitors the envelope signal-to-noise ratio across the tuned circuit and feeds the detected noise to the muting amplifier and switch. Excessive noise in the signal causes a control voltage to be applied to the audio subtractor circuit which mutes the audio. When S277 is closed, audio muting is defeated by shunting the control voltage to ground through R536.

Level detectors monitor the IF signal levels at the three amplifier/limiter stages and at the tuned circuit. Each limiter, beginning with the last, saturates progressively as the input level increases. Rectified signals from the level detectors are summed and applied as a linear-log voltage to the signal meter.

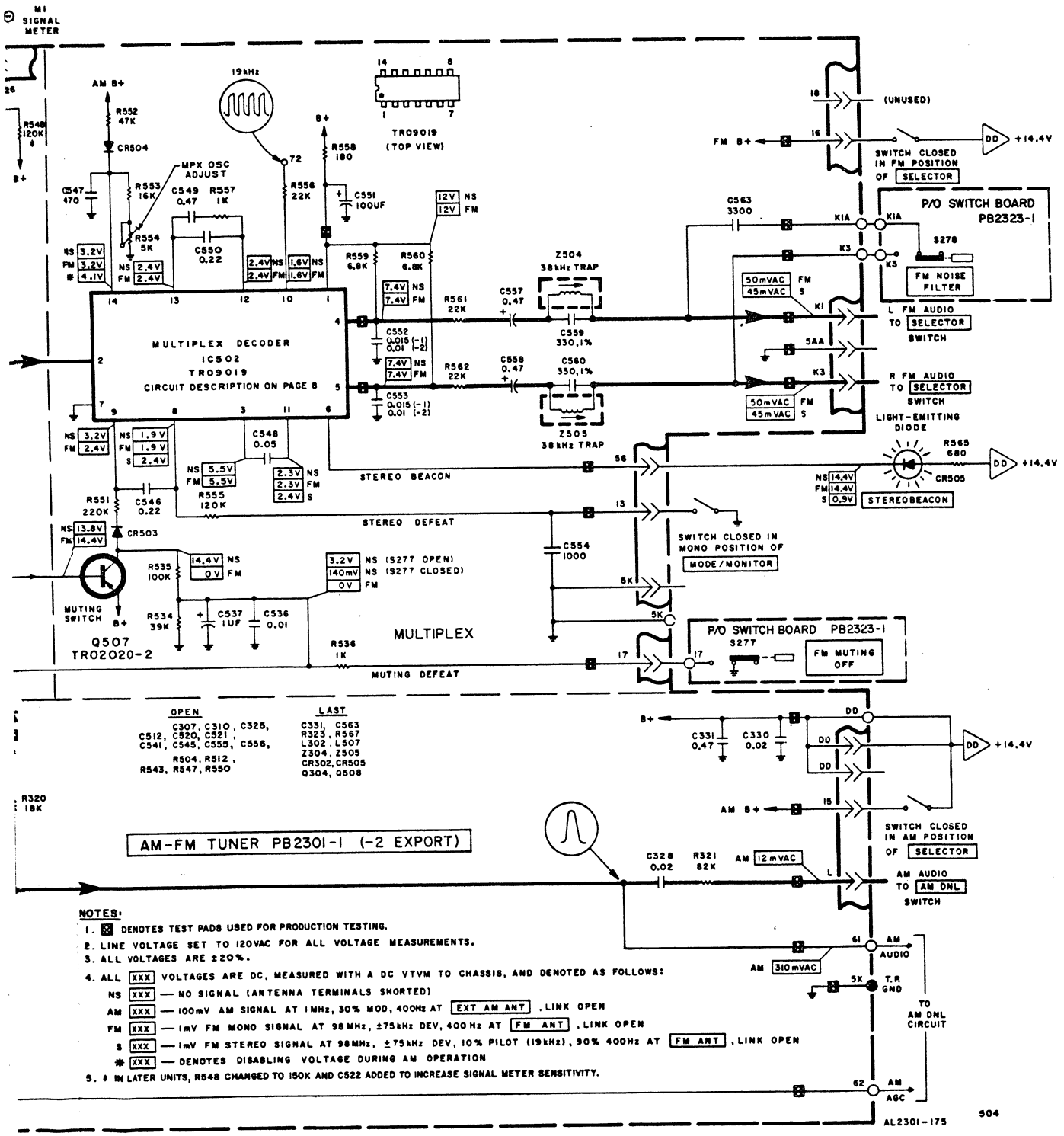
An AGC voltage for the RF amplifier is obtained from the first level detector. This AGC voltage is delayed until the IF signal in the first amplifier approaches limiting.

MPX IC

When the receiver is tuned to a stereo broadcast the composite audio fed to pin 2 consists of sum-and-difference signal information (L+R and L-R), and a 19kHz pilot tone. The L+R information is in the form of normal audio. The L-R information is Amplitude Modulated on a suppressed 38kHz subcarrier. (At the transmitter, the subcarrier is derived from the pilot tone through a frequency-doubler.) In order to extract the L-R information, it is necessary to regenerate the 38kHz subcarrier and apply it, together with the composite signal, to the decoder. Left and Right channel information is then decoded by addition and subtraction of the L+R and L-R information.

The top line of the block diagram shows the 38kHz subcarrier regeneration loop. The 76kHz oscillator output is processed through two frequency divider stages to furnish 38kHz and 19kHz outputs. The 19kHz output is a quadrature (90° out-of-phase) signal which is applied to the modulator. When the composite input signal contains a 19kHz pilot tone (stereo broadcast) the 19kHz quadrature signal is phase-compared to the pilot signal and the resulting DC voltage fed through the DC amp to the oscillator, where it corrects the frequency. As a result, the oscillator is continuously phase-locked to the pilot signal. The setting of R554 determines the frequency of the free-running oscillator. With the oscillator phase-locked to the pilot, the 38kHz output from the first divider is in the correct phase for decoding a stereo signal. The regenerated 38kHz signal is fed to the decoder via a stereo switch. The stereo switch closes when a sufficiently large 19kHz pilot tone is detected in the second modulator-comparator circuit. A third frequency divider stage, which processes signals derived from the first two dividers, returns a 19kHz in-phase signal to the second modulator-comparator for pilot detection. The DC voltage derived from the second modulator-comparator circuit is applied to the trigger which activates the STEREO-BEACON indicator and the stereo switch.

The circuit is forced into the monophonic mode by grounding pin 8, or applying a positive DC voltage to pin 9. With very low-level, noisy FM signals, a negative voltage (derived from the IF muting amplifier) forward biases Q507, forcing the circuit into mono. During AM operation the positive DC voltage applied to pin 14 disables the 76kHz oscillator to eliminate interference with AM reception.



OPEN

C307, C310, C325, C512, C520, C521, C541, C545, C555, C556, R504, R512, R543, R547, R550

LAST

C331, C563, R323, R567, L302, L507, Z304, Z505, CR302, CR505, Q304, Q508

NOTES:

1. ⊠ DENOTES TEST PADS USED FOR PRODUCTION TESTING.
2. LINE VOLTAGE SET TO 120VAC FOR ALL VOLTAGE MEASUREMENTS.
3. ALL VOLTAGES ARE ±20%.
4. ALL [XXX] VOLTAGES ARE DC, MEASURED WITH A DC VTVM TO CHASSIS, AND DENOTED AS FOLLOWS:
   - NS [XXX] — NO SIGNAL (ANTENNA TERMINALS SHORTED)
   - AM [XXX] — 100mV AM SIGNAL AT 1MHz, 30% MOD, 400Hz AT [EXT AM ANT], LINK OPEN
   - FM [XXX] — 1mV FM MONO SIGNAL AT 98MHz, ±75kHz DEV, 400Hz AT [FM ANT], LINK OPEN
   - S [XXX] — 1mV FM STEREO SIGNAL AT 98MHz, ±75kHz DEV, 10% PILOT (19kHz), 90% 400Hz AT [FM ANT], LINK OPEN
   - * [XXX] — DENOTES DISABLING VOLTAGE DURING AM OPERATION
5. # IN LATER UNITS, R548 CHANGED TO 150K AND C522 ADDED TO INCREASE SIGNAL METER SENSITIVITY.

TUNER ALIGNMENT

FM ALIGNMENT – AUDIO DISPLAY and FM MUTING OFF depressed, TONE CONTROLS and MASTER BALANCE to center. SPEAKERS to PHONES ONLY, MODE/MONITOR to STEREO, SELECTOR to FM, MASTER VOLUME to MIN.

Maintain generator output as low as possible for suitable indication.

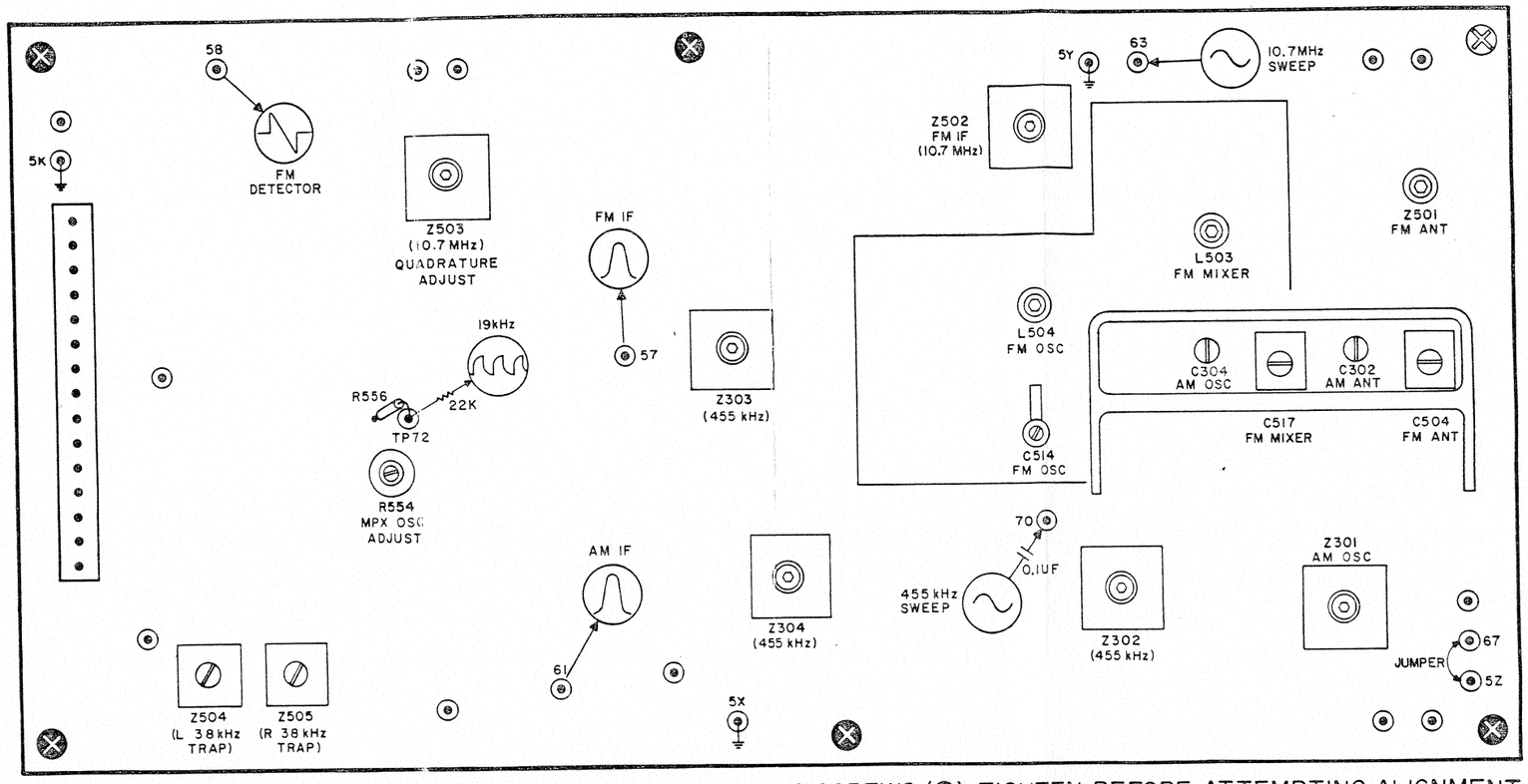
ITEM	GENERATOR	DIAL SETTING	INDICATOR	PROCEDURE
Note: The FM IF circuit utilizes a non-tunable ceramic filter which establishes the IF bandpass. To insure symmetrical tuning and selectivity, the IF must be aligned precisely to the center of the filter bandpass, rather than to 10.7 MHz as in conventional LC circuits.				
1. IF ALIGNMENT	Connect 10.7 MHz sweep to pin 63, gnd to pin 5Y. Markers are not required.	Position of non-interference	Scope vert input to pin 57, gnd to pin 5K.	Adjust Z502 top and bottom slugs for max gain and best symmetry. Keep signal low enough for noise on response as shown in FM IF.
2. PRELIMINARY DETECTOR ALIGNMENT	10.7 MHz sweep to pin 63, gnd to pin 5Y. Adjust for S-curve display.	Position of non-interference	Scope vert input to pin 58, gnd to pin 5K, front panel center-of-channel meter M2.	Adjust Z503 top slug for max gain, best linearity, and zero deflection of M2. Adjust bottom slug for minimum gain and best linearity. See FM DETECTOR response. Note: Minimum THD test must be performed as part of detector alignment.
Note: 120-ohm composition resistors in series with each lead from the RF generator match the 50-ohm output to the 300-ohm input impedance. Generator output voltage is reduced to one-half at antenna terminals. Signal voltages specified in this table are generator output levels, not antenna voltages.				
3. FRONT END ALIGNMENT		Tuning knob fully CCW.		Center dial pointer on 0 and cement.
4.	FM generator to FM ANTenna terminals through 120-ohm resistors. Set to 90 MHz. Adjust output for approx 2 on M1.	Center of 90 MHz calibration mark on dial.	Front panel signal meter M1, center-of-channel meter M2.	Adjust L504, L503, Z501 for max deflection of M1, zero deflection of M2. Reduce generator output to keep M1 indication at approx 2.
5.	Set to 106 MHz	Center of 106 MHz calibration mark on dial.	Front panel signal meter M1, center-of-channel meter M2.	Adjust C514, C517, C504 for max deflection of M1, zero deflection of M2. Reduce generator output to keep M1 indication at approx 2. Repeat steps 4 and 5 for max signal and accurate dial calibration.
6. FINAL DETECTOR ALIGNMENT (MINIMUM THD)	Set to position of non-interference. Modulate with 400 Hz, ±75 kHz deviation.	Tune to generator.	Scope vert input to OUT TO RCDR FRONT LEFT jack.	Reduce generator output for noise visible on sine wave. Readjust generator frequency to center noise on positive and negative half cycles. See SYMMETRICAL TUNING response. Note: Do not change generator or receiver tuning; proceed with minimum THD adjustment.
7.	Increase generator output to 2 mV.		Front panel center-of-channel meter M2, AC VTVM and HD analyzer to OUT TO RCDR FRONT LEFT jack.	Adjust Z503 top slug for zero deflection of M2. Adjust bottom slug for minimum THD (0.2% typical). Readjust top slug for zero deflection of M2.
8. MUTING TEST	Reduce generator output to 4 uV. Modulate with 400 Hz, ± 25 kHz deviation.	Tune to generator.	AC VTVM and scope vert input to OUT TO RCDR FRONT LEFT jack.	Release FM MUTING OFF pushbutton. Audio should disappear. Increase generator output to 16 uV. Audio should reappear on scope. (No adjustment.)

L SETTING	INDICATOR	PROCEDURE
› generator. FM MUTING ıshbutton.	Connect frequency counter to TP 72.	Adjust R554 for indication of 19,000 Hz (±50 Hz).
› generator. FM MUTING ıshbutton.	Scope vert input to TP 72 through 22K. Scope hor input to MPX generator 19,000 Hz pilot output.	Adjust R554 for stable Lissajou display as shown in MPX OSC response.
	Scope vert input to audio oscillator output. Scope hor input to MPX generator 19,000 Hz pilot output.	Adjust osc frequency for stable 2:1 Lissajou display (38,000 Hz). Note: Do not change osc frequency; proceed with 38 kHz trap adjustment.
› generator.	AC VTVM and scope vert input to OUT TO RCDR FRONT LEFT jack, another AC VTVM and scope to FRONT RIGHT jack.	Adjust Z504 and Z505 for minimum (typically more than 40 dB below audio level).

ed, TONE CONTROLS and MASTER BALANCE to center. SPEAKERS to ;TEREO, SELECTOR to AM, MASTER VOLUME to MIN.

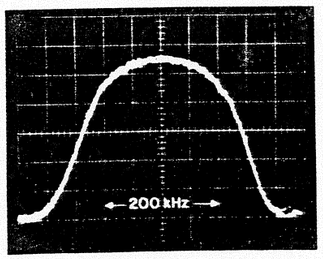
: as low as possible for suitable indication.

L SETTING	INDICATOR	PROCEDURE
n of non- ence near Hz.	Scope vert input to pin 61, gnd to pin 5X.	Connect a jumper between pin 67 and pin 5Z. Adjust Z304, Z303, Z302 top and bottom slugs for max gain and best symmetry. Keep signal low enough for noise on response as shown in AM IF. Disconnect jumper.
of 600 kHz tion mark on	Front panel signal meter, M1.	Adjust Z301 and L300 (antenna) for max deflection. Reduce generator output to keep panel meter at approx 3.
of 1400 kHz tion mark on	Front panel signal meter, M1.	Adjust C304 and C302 for max deflection. Keep meter at approx 3. Repeat steps 2 and 3 for max signal and accurate dial calibration.

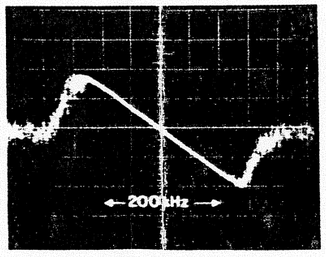


NOTE: CHASSIS GROUNDS ARE COMPLETED THROUGH MOUNTING SCREWS (⊗). TIGHTEN BEFORE ATTEMPTING ALIGNMENT.

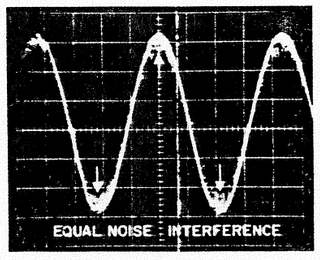
AL2301-177 304, 404, 504



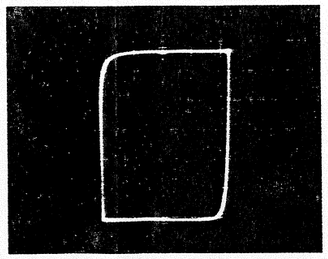
FM IF



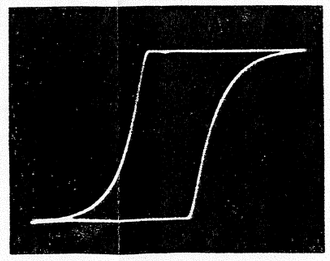
FM DETECTOR

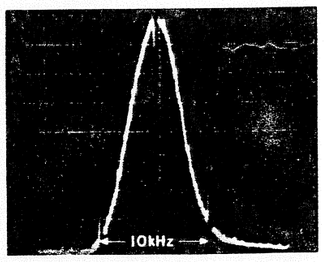


SYMMETRICAL TUNING



MPX OSC





AM IF

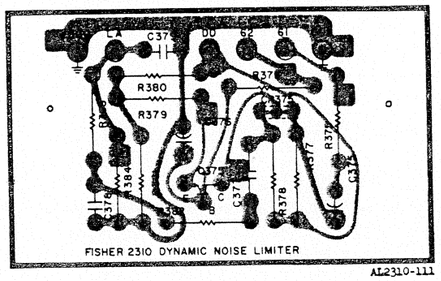
TUNER ALIGNMENT

ITEM	GENERATOR	DIAL SETTING	INDICATOR	PROCEDURE
9. MPX OSC ADJUSTMENT	Set to position of non-interference, with CW output of 2 mV.	Tune to generator. Release FM MUTING OFF pushbutton.	Connect frequency counter to TP 72.	Adjust R554 for indication of 19,000 Hz (±50 Hz).
ALTERNATE MPX OSC ADJUSTMENT	Set to position of non-interference, with CW output of 2 mV.	Tune to generator. Release FM MUTING OFF pushbutton.	Scope vert input to TP 72 through 22K. Scope hor input to MPX generator 19,000 Hz pilot output.	Adjust R554 for stable Lissajou display as shown in MPX OSC response.
10. 38 kHz TRAP ADJUSTMENT			Scope vert input to audio oscillator output. Scope hor input to MPX generator 19,000 Hz pilot output.	Adjust osc frequency for stable 2:1 Lissajou display (38,000 Hz). Note: Do not change osc frequency; proceed with 38 kHz trap adjustment.
11.	Modulate generator with 38,000 Hz, ±75 kHz deviation. Set generator output to 2 mV.	Tune to generator.	AC VTVM and scope vert input to OUT TO RCDR FRONT LEFT jack, another AC VTVM and scope to FRONT RIGHT jack.	Adjust Z504 and Z505 for minimum (typically more than 40 dB below audio level).

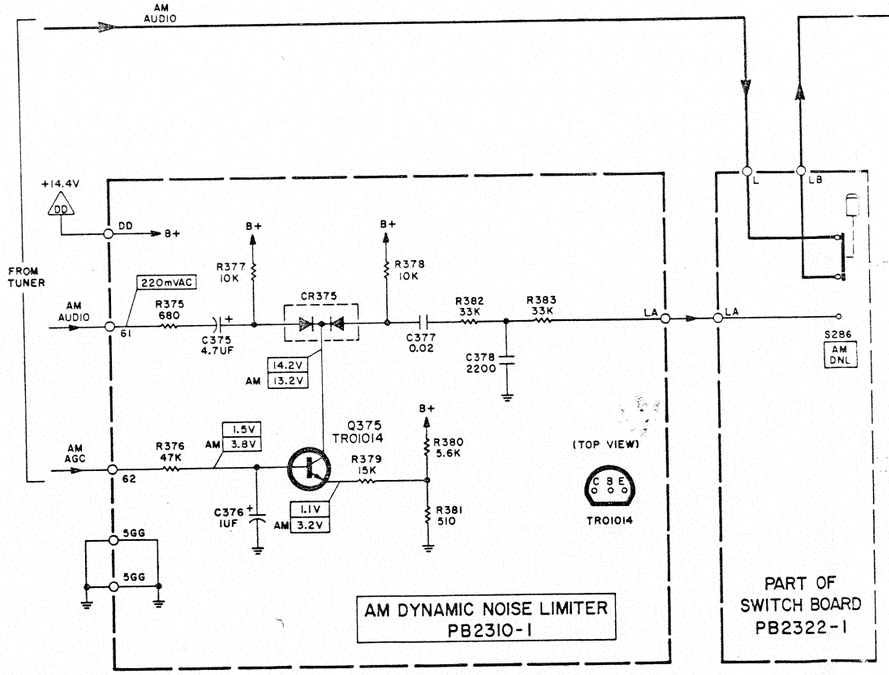
AM ALIGNMENT — AUDIO DISPLAY and AM DNL depressed, TONE CONTROLS and MASTER BALANCE to center. SPEAKERS to PHONES ONLY, MODE/MONITOR to STEREO, SELECTOR to AM, MASTER VOLUME to MIN.

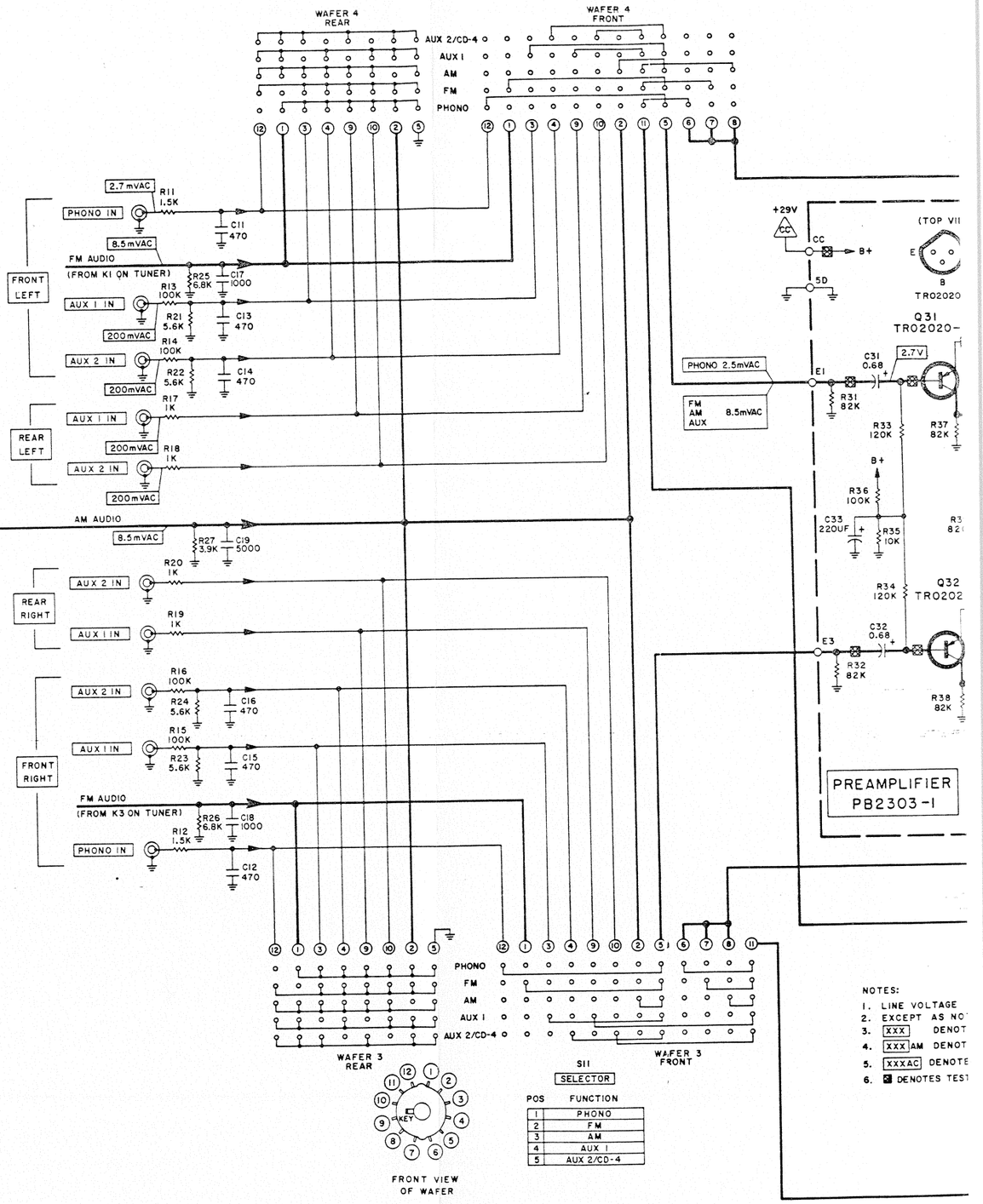
Maintain generator output as low as possible for suitable indication.

ITEM	GENERATOR	DIAL SETTING	INDICATOR	PROCEDURE
1. IF ALIGNMENT	455 kHz sweep generator to pin 70, gnd to pin 5X. Use 0.1 uF capacitor in series with generator lead.	Position of non-interference near 1400 kHz.	Scope vert input to pin 61, gnd to pin 5X.	Connect a jumper between pin 67 and pin 5Z. Adjust Z304, Z303, Z302 top and bottom slugs for max gain and best symmetry. Keep signal low enough for noise on response as shown in AM IF. Disconnect jumper.
2. FRONT END ALIGNMENT	AM generator to EXT AM ANT and GND terminals. Open GND link. Set to 600 kHz. Modulate with 400 Hz, 30% modulation.	Center of 600 kHz calibration mark on dial.	Front panel signal meter, M1.	Adjust Z301 and L300 (antenna) for max deflection. Reduce generator output to keep panel meter at approx 3.
3.	Set to 1400 kHz.	Center of 1400 kHz calibration mark on dial.	Front panel signal meter, M1.	Adjust C304 and C302 for max deflection. Keep meter at approx 3. Repeat steps 2 and 3 for max signal and accurate dial calibration.

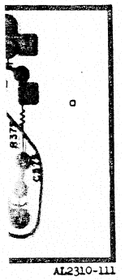


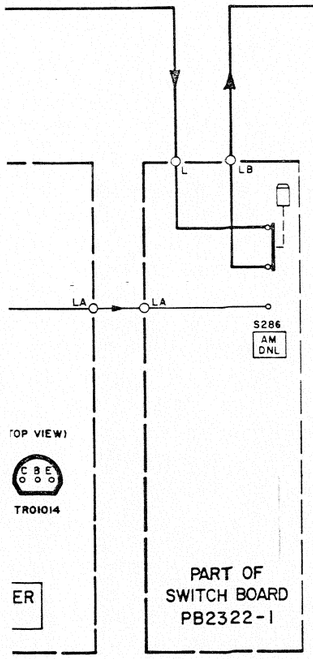
AL2310-111

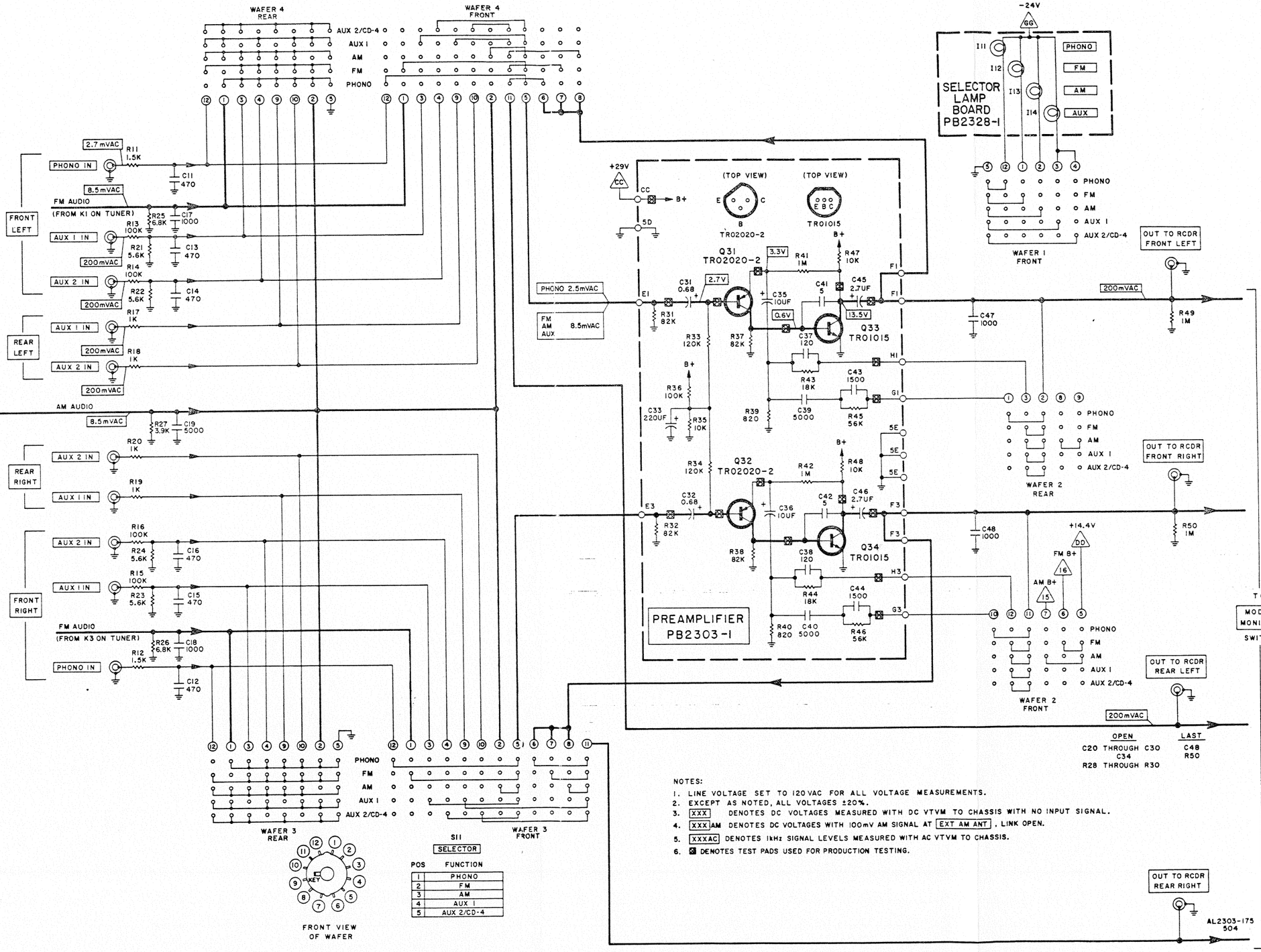




NOTES:
1. LINE VOLTAGE
2. EXCEPT AS NO
3. XXX DENOT
4. XXX AM DENOT
5. XXXAC DENOTE
6. ■ DENOTES TEST

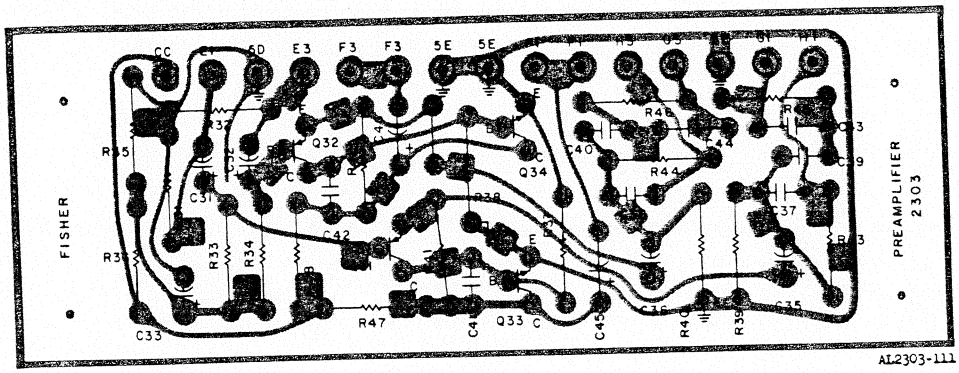






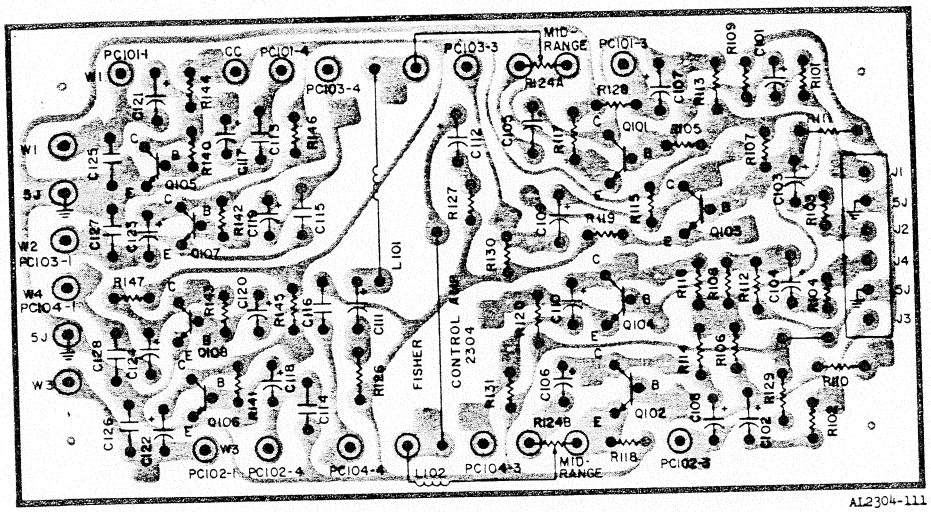
NOTES:

1. LINE VOLTAGE SET TO 120 VAC FOR ALL VOLTAGE MEASUREMENTS.
2. EXCEPT AS NOTED, ALL VOLTAGES ±20%.
3. [XXX] DENOTES DC VOLTAGES MEASURED WITH DC VTVM TO CHASSIS WITH NO INPUT SIGNAL.
4. [XXX]AM DENOTES DC VOLTAGES WITH 100mV AM SIGNAL AT [EXT AM ANT], LINK OPEN.
5. [XXXAC] DENOTES 1kHz SIGNAL LEVELS MEASURED WITH AC VTVM TO CHASSIS.
6. ⊠ DENOTES TEST PADS USED FOR PRODUCTION TESTING.



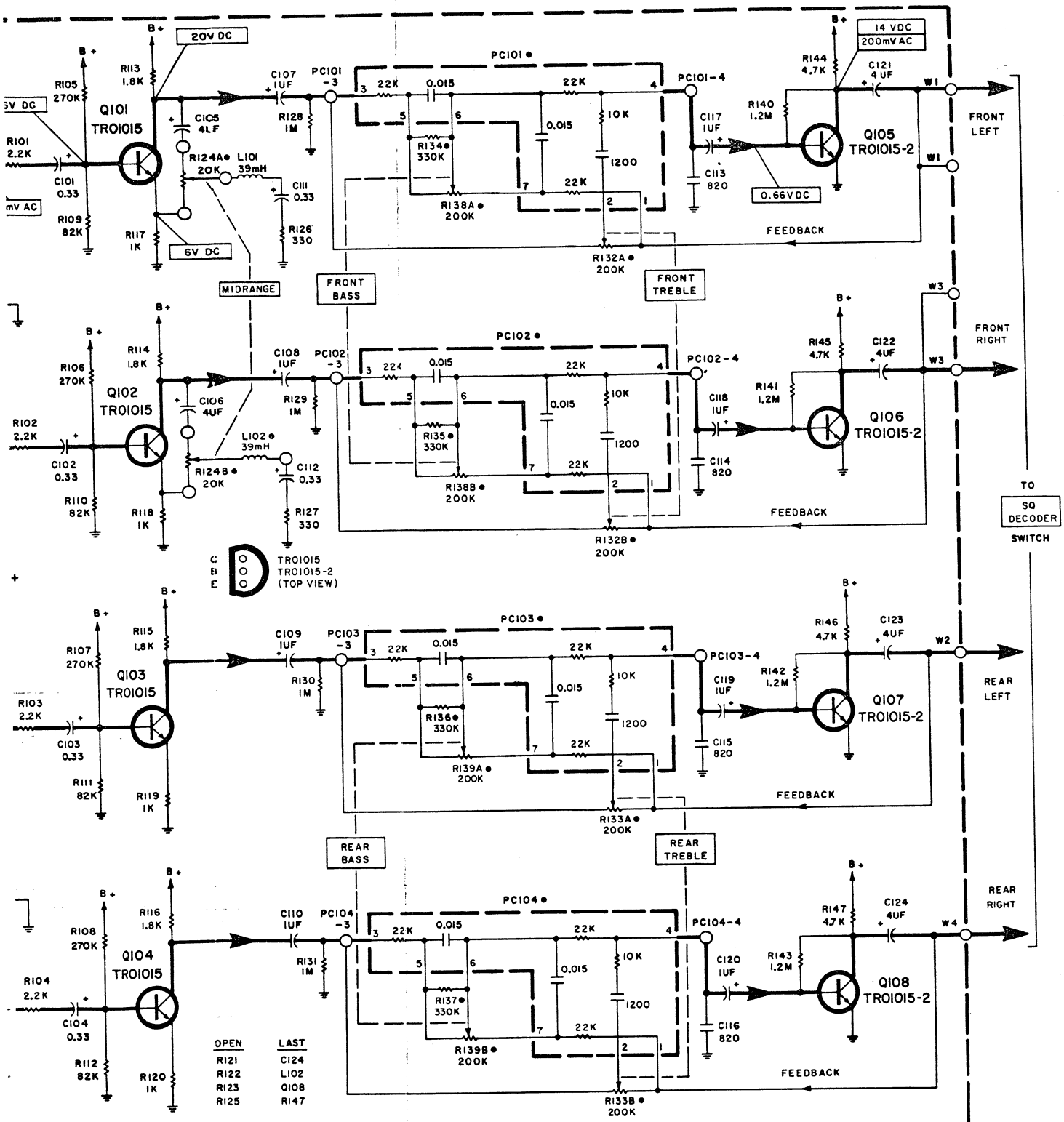
Symbol	Description	Part Number	Sug. Ret.
C11, 12, 13, 14, 15, 16	Ceramic, 470pF, 10%, 50V	CK22358-8	.30
C17, 18, 47, 48	Ceramic, 1000pF, 10%, 50V	CK22358-12	.30
C19	Ceramic, 5000pF, 10%, 50V	CK22355-2	.30
C31, 32	Tantalum, 0.68UF, 35V	CL22306-2	.75
C33	Electrolytic, 220UF, 10V	CE22342-16	.40
C35, 36	Electrolytic, 10UF, 50V	CE22342-4	.35
C37, 38	Ceramic, 120pF, 10%, 50V	CK22350-1	.30
C39, 40	Ceramic, 5000pF, 20%, 50V	CK22349-2	.30
C41, 42	Ceramic, 5pF, 5%, NPO, 50V	CK22344-1	.30
C43, 44	Ceramic, 1500pF, 10%, 50V	CK22351-8	.30
C45, 46	Tantalum, 2.7UF, 35V	CL22305-4	.75
C375	Electrolytic, 4.7UF, 50V	CE22342-3	.35
C376	Electrolytic, 1UF, 50V	CE22342-2	.35
C377	Ceramic, 0.02UF, 20%	CK22349-3	.30
C378	Ceramic, 2200pF, 10%	CK22347-15	.30
CR375	Diode, Varactor	TR17001-5	1.05
I11, 12, 13, 14	Lamp, Sub-Miniature	LM21421-4	.70
Q31, 32	Transistor, PNP (2N4250)	TR02020-2	.55
Q33, 34	Transistor, NPN (BC414C)	TR01015	.85
Q375	Transistor, NPN (BC239C)	TR01014	.70
R11, 12	1.5K	RF25DC152J	.30
R13, 14, 15, 16, 36	100K	RF25DC104J	.30
R17, 18, 19, 20	1K	RF25DC102J	.30
R21, 22, 23, 24, 380	5.6K	RF25DC562J	.30
R25, 26	6.8K	RF25DC682J	.30
R27	3.9K	RF25DC392J	.30
R31, 32, 37, 38	82K	RF25DC823J	.30
R33, 34	120K	RF25DC124J	.30
R35, 47, 48, 377, 378	10K	RF25DC103J	.30
R39, 40	820	RF25DC821J	.30
R41, 42, 49, 50	1M	RF25DC105J	.30
R43, 44	18K	RF25DC183J	.30
R45, 46	56K	RF25DC563J	.30
R375	680	RF25DC681J	.30
R376	47K	RF25DC473J	.30
R379	15K	RF25DC153J	.30
R381	510	RF25DC511J	.30
R382, 383	33K	RF25DC333J	.30
S11	Switch, SELECTOR	SR4094-150	7.50
S286	p/o 4-Switch Assembly	SP50200-59	3.45

Resistors are deposited Film, 5%, ¼W. K=Kilohm M=Megohm



Symbol	Description	Part Number	Sug. Ret.
C101, 102, 103, 104, 111, 112	Sintered Aluminum, 0.33UF, 25V	CS22340-3	.45
C105, 106, 121, 122, 123, 124	Tantalum, 4UF, 35V	CL22305-14	.80
C107, 108, 109, 110	Tantalum, 1UF, 35V	CL22305-3	.60
C113, 114, 115, 116	Ceramic, 820pF, 10%, 50V	CK22347-11	.30
C117, 118, 119, 120	Sintered Aluminum, 1UF, 25V	CS22340-5	.45
I9, 10	Lamp, Sub-Miniature	LM21421-4	.70
L101, 102	Choke, 39mH	L50334-11	1.05
PC101, 102, 103, 104	Encapsulated Circuit	EP50187-87	1.60
Q101, 102, 103, 104	Transistor, NPN (BC414C)	TR01015	.85
Q105, 106, 107, 108	Transistor NPN (BC414B)	TR01015-2	1.15
R81, 82, 83, 84	22K	RF25DC223J	.30
R85, 86, 87, 88, 89, 90 91, 92	56K	RF25DC563J	.30
R101, 102 103, 104	2.2K	RF25DC222J	.30
R105, 106, 107, 108	270K	RF25DC274J	.30
R109, 110, 111, 112	82K	RF25DC823J	.30
R113, 114, 115, 116	1.8K	RF25DC182J	.30
R117, 118, 119, 120	1K	RF25DC102J	.30
R124A, B	Potentiometer, 20K Dual-Slide	RP50160-286	3.00
R126, 127	330	RF25DC331J	.30
R128, 129, 130, 131	1M	RF25DC105J	.30
R132A, B, 133A, B, 138A, B, 139A, B	Potentiometer, 200K Dual-Slide	RP50160-285	2.75
R134, 135, 136, 137	330K	RF25DC334J	.30
R140, 141, 142, 143	1.2M	RF25DC125J	.30
R144, 145, 146, 147	4.7K	RF25DC472J	.30
S81	Switch, MODE/MONITOR	SR4094-154	6.75
--	Connector, 6-Pin Male	HH20685-6	.50
--	Connector, 6-Pin Female	HH20683-6	.45

Resistors are Deposited Film, 5%, ¼W. K=Kilohm M=Megohm



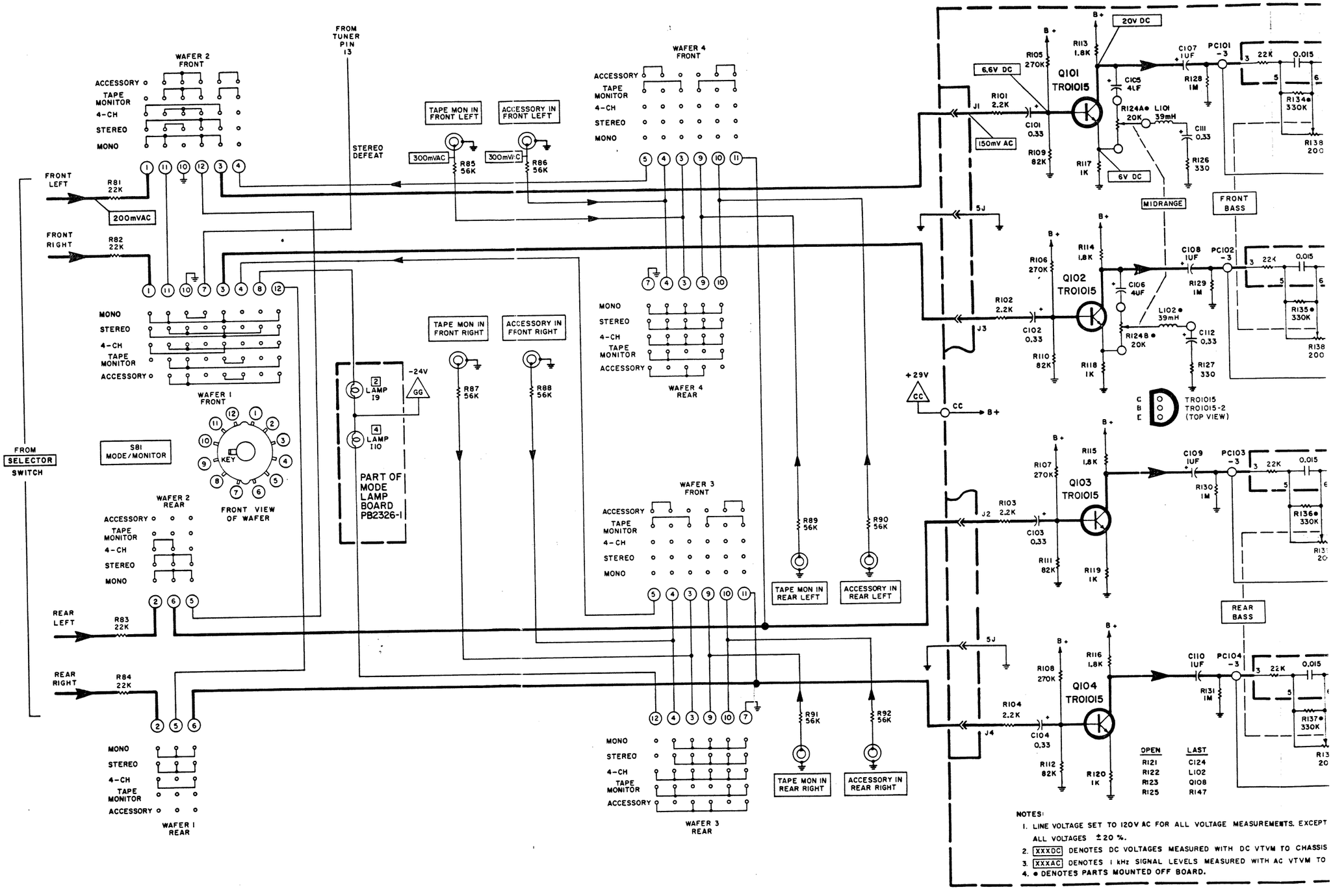
NOTES:

1. LINE VOLTAGE SET TO 120V AC FOR ALL VOLTAGE MEASUREMENTS. EXCEPT AS NOTED, ALL VOLTAGES ±20 %.
2. [XXXDC] DENOTES DC VOLTAGES MEASURED WITH DC VTVM TO CHASSIS WITH NO INPUT SIGNAL.
3. [XXXAC] DENOTES 1 kHz SIGNAL LEVELS MEASURED WITH AC VTVM TO CHASSIS.
4. • DENOTES PARTS MOUNTED OFF BOARD.

CONTROL AMPLIFIER PB2304-1

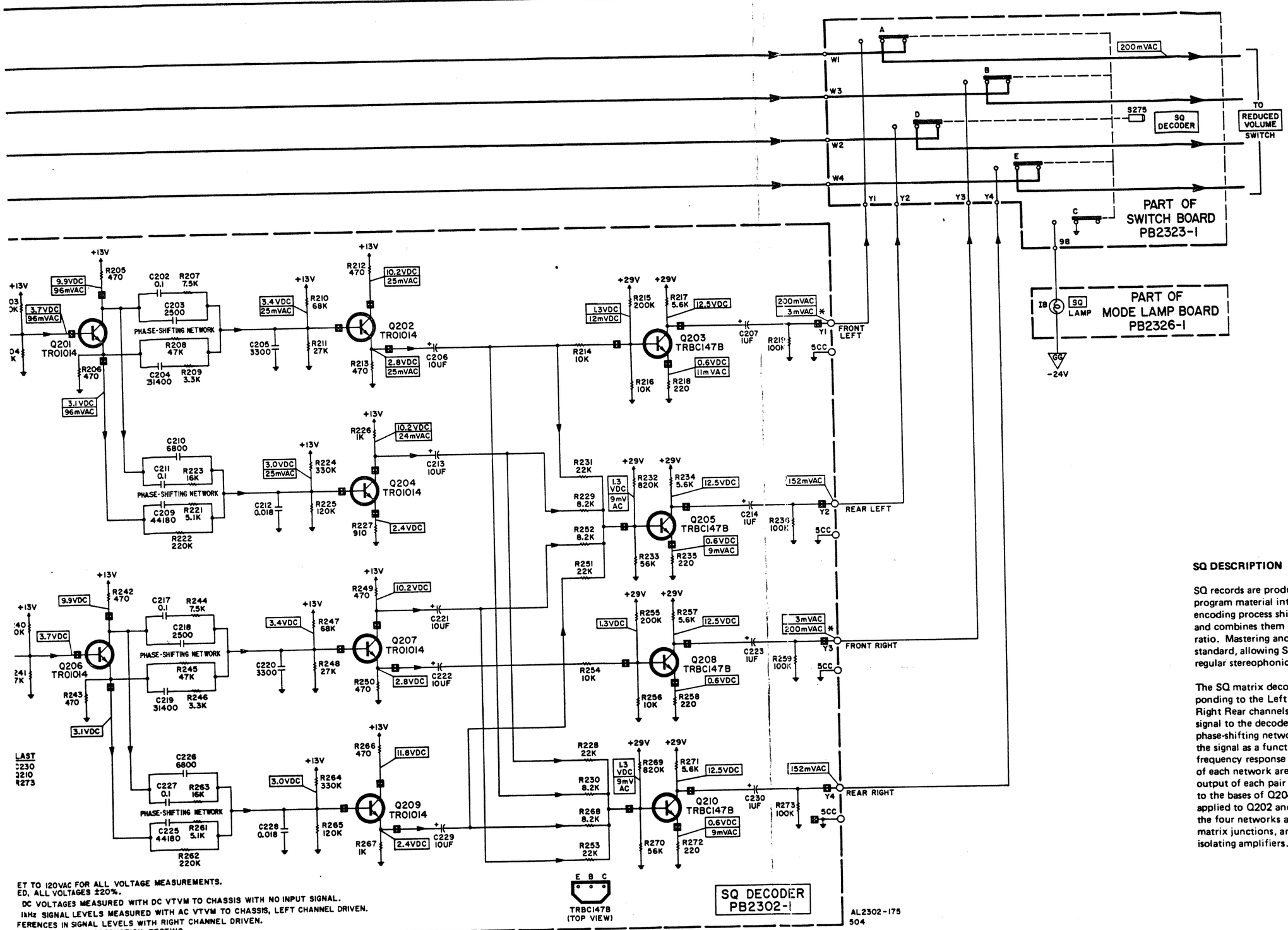
AL2304-175 504

MODE/MONITOR SWITCH



NOTES:

1. LINE VOLTAGE SET TO 120V AC FOR ALL VOLTAGE MEASUREMENTS. EXCEPT ALL VOLTAGES ±20 %.
2. [XXXDC] DENOTES DC VOLTAGES MEASURED WITH DC VTVM TO CHASSIS
3. [XXXAC] DENOTES 1 kHz SIGNAL LEVELS MEASURED WITH AC VTVM TO
4. ● DENOTES PARTS MOUNTED OFF BOARD.

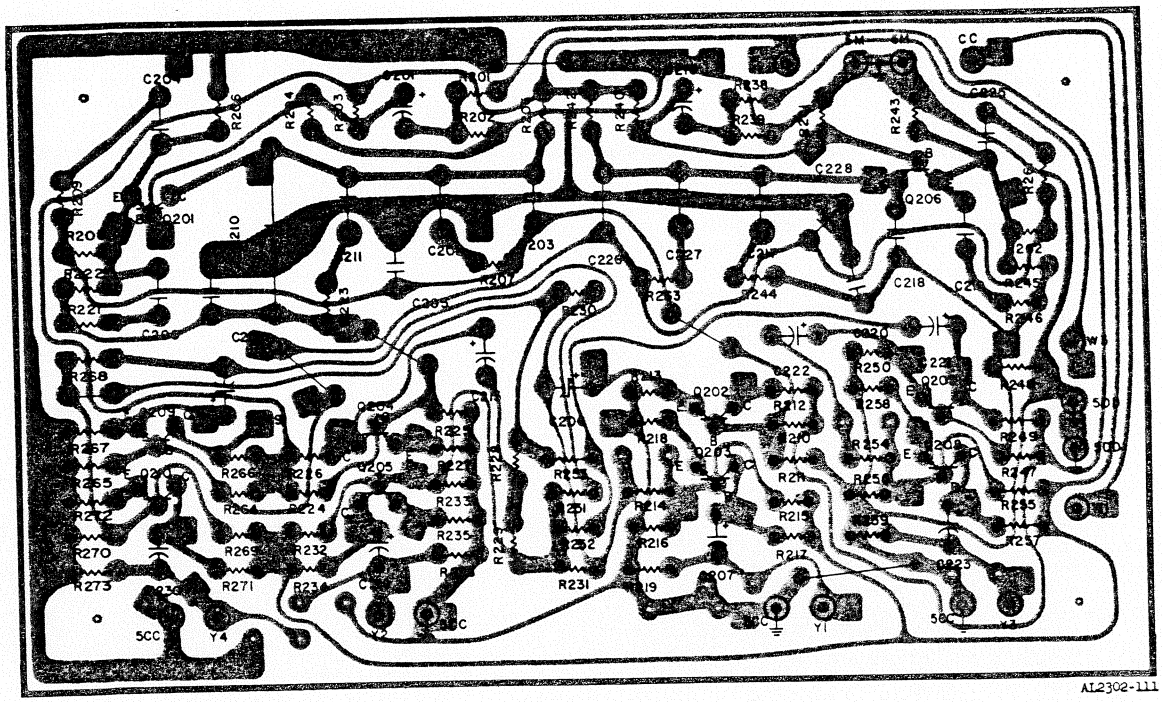


ET TO 120VAC FOR ALL VOLTAGE MEASUREMENTS.
ED, ALL VOLTAGES ±20%.
DC VOLTAGES MEASURED WITH DC VTVM TO CHASSIS WITH NO INPUT SIGNAL.
1kHz SIGNAL LEVELS MEASURED WITH AC VTVM TO CHASSIS, LEFT CHANNEL DRIVEN.
FERENCES IN SIGNAL LEVELS WITH RIGHT CHANNEL DRIVEN.
3T PADS USED FOR PRODUCTION TESTING.

SQ DESCRIPTION

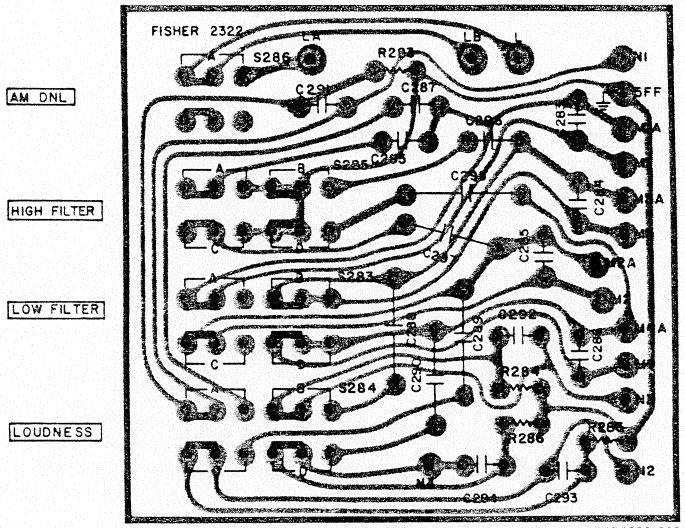
SQ records are produced by combining four channels of program material into two through a matrix encoder. The encoding process shifts the phase of the rear channels 90° and combines them with the front channels in a specified ratio. Mastering and pressing procedures for SQ records are standard, allowing SQ records to be played back with regular stereophonic pick-ups.

The SQ matrix decoder extracts the four signals corresponding to the Left Front, Left Rear, Right Front, and Right Rear channels of the original program. Each input signal to the decoder is amplified, then processed by two phase-shifting networks. Each network shifts the phase of the signal as a function of frequency without affecting frequency response or level of the signal. The characteristics of each network are similar except that the signals at the output of each pair are in quadrature. (The signals applied to the bases of Q204 and Q209 lag 90° behind the signals applied to Q202 and Q207 respectively.) The outputs of the four networks are amplified, then summed at two matrix junctions, and fed to the output terminals through isolating amplifiers.

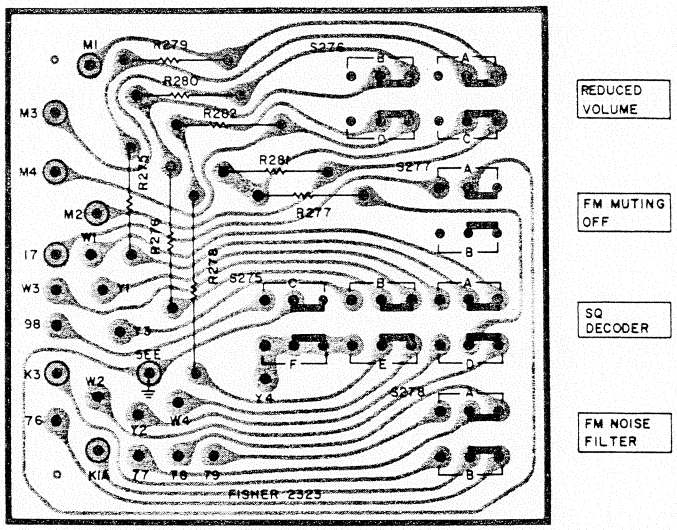


Symbol	Description	Part Number	Sug. Ret.
C201, 216	Electrolytic, 4.7UF, 50V	CE22342-3	.35
C202, 211, 217, 227	Mylar, 0.1UF, 5%, 160V	C50B646-9	.45
C203, 218	Polystyrene, 2500pF, 5%, 33V	C51B256-37	.45
C204, 219	Mylar, 31400pF, 5%, 50V	CY22356-7	.50
C205, 220	Polystyrene, 3300pF, 5%, 33V	C51B256-21	.45
C206, 213, 221, 222, 229	Electrolytic, 10UF, 50V	CE22342-4	.35
C207, 214, 223, 230	Tantalum, 1UF, 35V	CL22305-3	.60
C208	Electrolytic, 220UF, 16V	CE22342-15	.40
C209, 225	Mylar, 44180pF, 5%, 50V	CY22356-8	.50
C210, 226	Polystyrene, 6800pF, 5%, 33V	C51B256-25	.50
C212, 228	Polystyrene, 0.018UF, 5%, 33V	C51B256-38	.70
I8	Lamp, Sub-Miniature	LM21421-4	.70
Q201, 202, 204, 206, 207, 209	Transistor, NPN (BC239C)	TR01014	.70
Q203, 205, 208, 210	Transistor, NPN (BC147B)	TRBC147B	1.00
R201, 211, 238, 248	27K	RF25DC273J	.30
R202, 239	470K	RF25DC474J	.30
R203, 219, 236, 240, 259, 273	100K	RF25DC104J	.30
R204, 208, 241, 245	47K	RF25DC473J	.30
R205, 206, 212, 213, 242, 243, 249, 250, 266	470	RF25DC471J	.30
R207, 244	7.5K	RF25DC752J	.30
R209, 246	3.3K	RF25DC332J	.30
R210, 247	68K	RF25DC683J	.30
R214, 216, 254, 256	10K	RF25DC103J	.30
R215, 255	200K	RF25DC204J	.30
R217, 234, 257, 271	5.6K	RF25DC562J	.30
R218, 235, 258, 272	220	RF25DC221J	.30
R221, 261	5.1K	RF25DC512J	.30
R222, 262	220K	RF25DC224J	.30
R223, 263	16K	RF25DC163J	.30
R224, 264	330K	RF25DC334J	.30
R225, 265	120K	RF25DC124J	.30
R226, 267	1K	RF25DC102J	.30
R227	910	RF25DC911J	.30
R228, 231, 251, 253	22K	RF25DC223J	.30
R229, 230, 252, 268	8.2K	RF25DC822J	.30
R232, 269	820K	RF25DC824J	.30
R233, 270	56K	RF25DC563J	.30
S275	p/o 4-Switch Assembly	SP50200-60	3.45

Resistors are Deposited Film, 5%, ¼W. K=Kilohm



See page 10 for schematic of AM DNL switch.

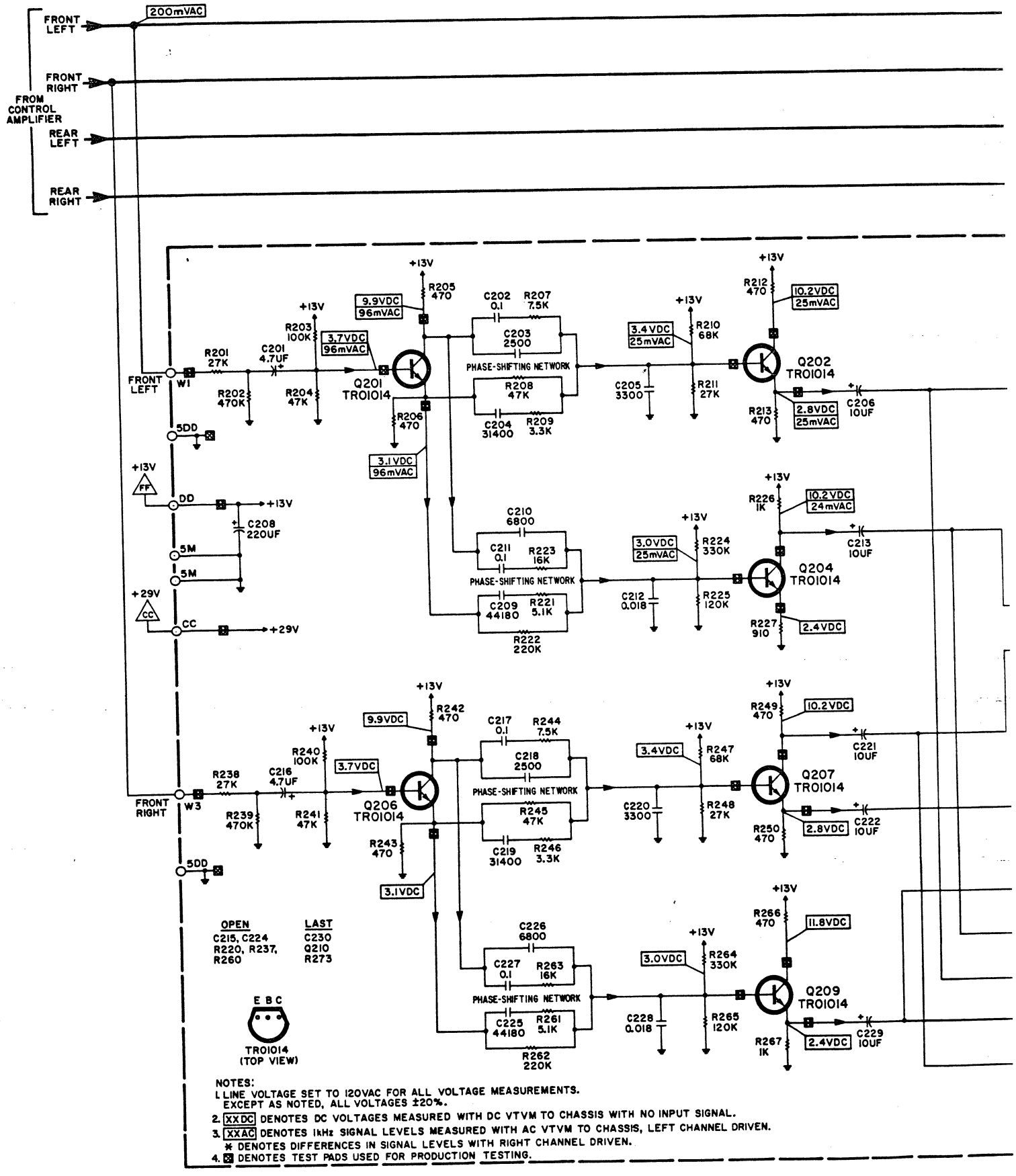


See page 7 for schematic of FM MUTING OFF and FM NOISE FILTER switches.

See page 14 for schematic of SQ DECODER switch.

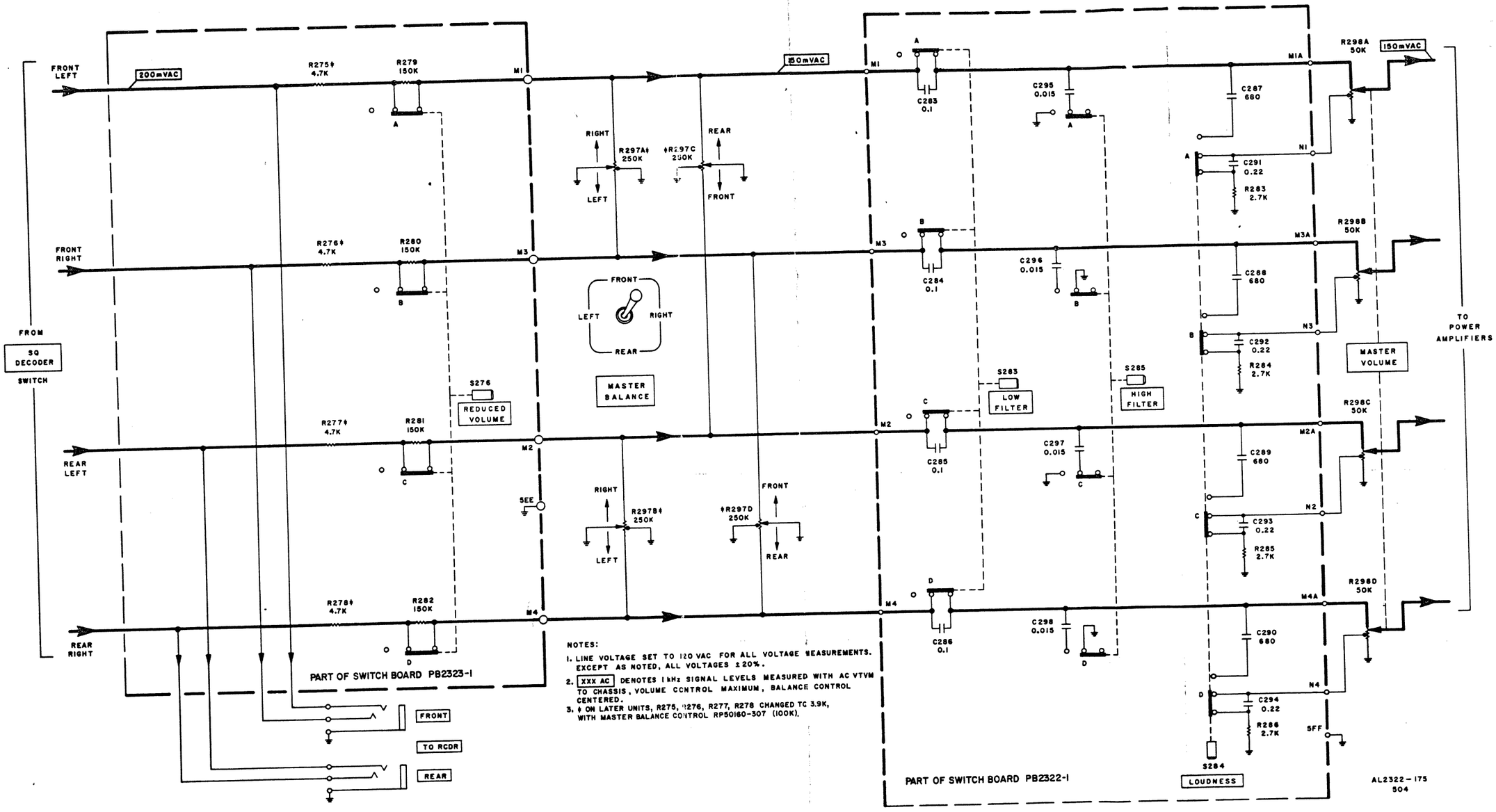
Symbol	Description	Part Number	Sug. Ret.
C283, 284, 285, 286	Mylar, 0.1UF, 10%, 250V	C50B575-1	.50
C287, 288, 289, 290	Ceramic, 680pF, 10%, 50V	CK22358-10	.30
C291, 292, 293, 294	Mylar, 0.22UF, 10%, 250V	C50B575-2	.60
C295, 296, 297, 298	Mylar, 0.015UF, 10%, 100V	C50B574-2	.40
R275, 276, 277, 278	4.7K	RF25DC472J	.30
R279, 280 281, 282	150K	RF25DC154J	.30
R283, 284, 285, 286	2.7K	RF25DC272J	.30
R297A, B, C, D	Control, MASTER BALANCE	RP50160-289	10.30
R298A, B, C, D	Control, MASTER VOLUME	RP50160-287	7.10
S276	p/o 4-Switch Assembly	SP50200-60	3.45
S283, 284, 285	p/o 4-Switch Assembly	SP50200-59	3.45
- -	Jack, TO RCDR-FRONT, REAR	JK20627-5	1.10

Resistors are Deposited Film, 5%, ¼W. K=Kilohm



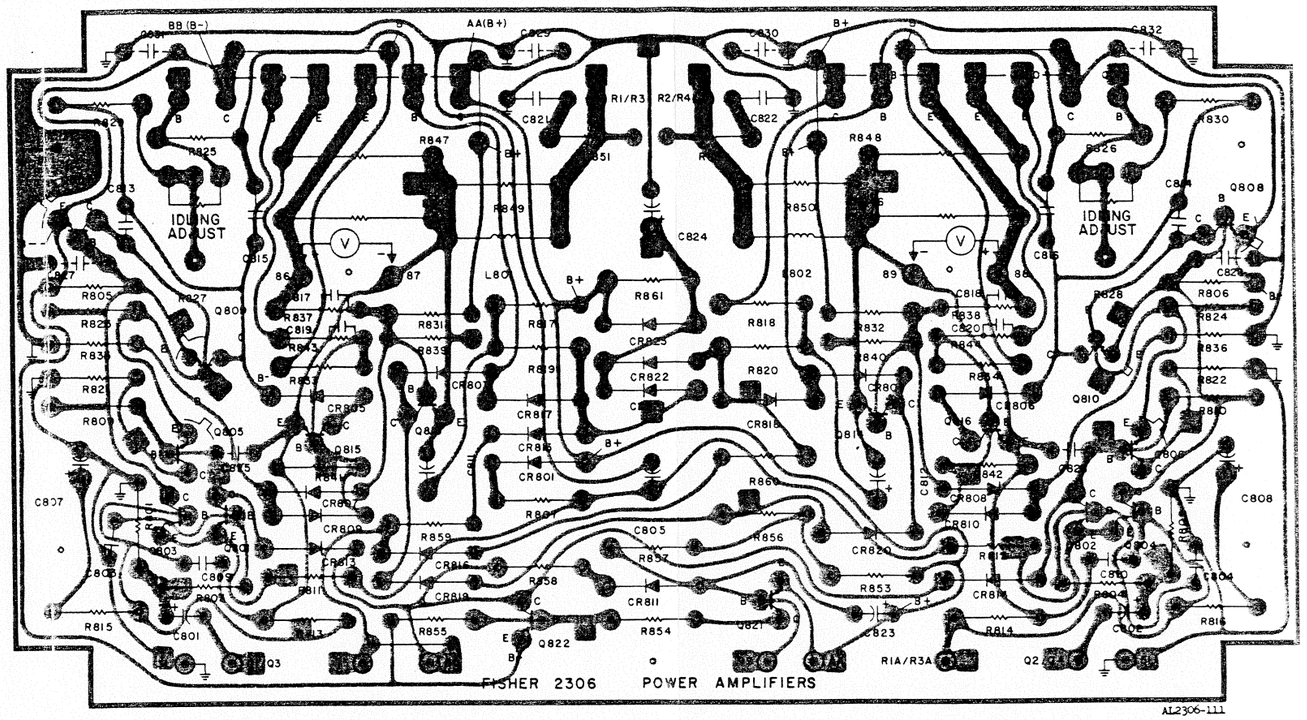
NOTES:

1. LINE VOLTAGE SET TO 120VAC FOR ALL VOLTAGE MEASUREMENTS. EXCEPT AS NOTED, ALL VOLTAGES ±20%.
2. [XX DC] DENOTES DC VOLTAGES MEASURED WITH DC VTVM TO CHASSIS WITH NO INPUT SIGNAL.
3. [XX AC] DENOTES 1kHz SIGNAL LEVELS MEASURED WITH AC VTVM TO CHASSIS, LEFT CHANNEL DRIVEN.
   * DENOTES DIFFERENCES IN SIGNAL LEVELS WITH RIGHT CHANNEL DRIVEN.
4. ⊠ DENOTES TEST PADS USED FOR PRODUCTION TESTING.


FRONT LEFT
200mVAC
R275♦ 4.7K
R279 150K
M1
150mVAC
A
C283 0.1
C295 0.015
R298A 50K
M1A
C287 680
RIGHT
R297A♦ 250K
♦R297C 250K
REAR
LEFT
FRONT
N1
C291 0.22
R283 2.7K
FRONT RIGHT
R276♦ 4.7K
R280 150K
M3
B
C284 0.1
C296 0.015
R298B 50K
M3A
C288 680
FROM SQ DECODER SWITCH
FRONT
LEFT
RIGHT
REAR
MASTER BALANCE
N3
C292 0.22
R284 2.7K
MASTER VOLUME
TO POWER AMPLIFIERS
S276
REDUCED VOLUME
S283
LOW FILTER
S285
HIGH FILTER
R277♦ 4.7K
R281 150K
M2
C
C285 0.1
C297 0.015
R298C 50K
M2A
C289 680
REAR LEFT
5EE
RIGHT
R297B♦ 250K
♦R297D 250K
FRONT
REAR
N2
C293 0.22
R285 2.7K
R278♦ 4.7K
R282 150K
M4
D
C286 0.1
C298 0.015
R298D 50K
M4A
C290 680
REAR RIGHT
N4
C294 0.22
R286 2.7K
5FF
S284
LOUDNESS
PART OF SWITCH BOARD PB2323-1
PART OF SWITCH BOARD PB2322-1
FRONT
TO RCDR
REAR
NOTES:
1. LINE VOLTAGE SET TO 120 VAC FOR ALL VOLTAGE MEASUREMENTS. EXCEPT AS NOTED, ALL VOLTAGES ±20%.
2. XXX AC DENOTES 1kHz SIGNAL LEVELS MEASURED WITH AC VTVM TO CHASSIS, VOLUME CONTROL MAXIMUM, BALANCE CONTROL CENTERED.
3. ♦ ON LATER UNITS, R275, 1276, R277, R278 CHANGED TO 3.9K, WITH MASTER BALANCE CONTROL RP50160-307 (100K).
AL2322-175
504

Symbol	Description	Part Number	Sug. Ret.
C801, 802	Tantalum, 1UF, 35V	CL22305-3	.60
C803, 804	Ceramic, 270pF, 10%, 50V	CK22350-5	.30
C805, 824	Electrolytic, 100UF, 50V	CE22342-9	.50
C806	Electrolytic, 470UF, 50V	CE22343-33	.95
C807, 808	Electrolytic, 100UF, 16V	CE22342-12	.40
C809, 810	Ceramic, 10pF, 10%, NP0, 50V	CK22345-3	.30
C811, 812	Electrolytic, 47UF, 35V	CE22342-7	.40
C813, 814	Ceramic, 56pF, 10%, N1500, 50V	CK22345-10	.30
C815, 816	Ceramic, 0.02UF, 20%, 50V	CK22349-3	.30
C817, 818, 819, 820	Ceramic, 0.05UF, +80-20%, 50V	CK22348-1	.35
C821, 822	Ceramic, 0.1UF, ±35%, 100V	C51163-1	.60
C823	Tantalum, 47UF, 6V	CL22305-16	.85
C825	Ceramic, 0.1UF, +80-20%, 50V	CK22361-3	.35
CR801, 803, 804, 805, 806, 807, 808, 809, 810, 811, 813, 814, 815, 816, 817, 818, 819, 820, 821, 822	Diode, Silicon	TR13006-3	.40
CR823	Diode, Silicon	SID51C052-19	.50
L801, 802	Choke, 3.3UH	LC21826	1.40
L803	Choke, 3.3UH	LC21814-2	.35
Q801, 802, 803, 804	Transistor, PNP	TR02063-8	1.00
Q805, 806, 807, 808	Transistor, NPN	TR01040	1.05
Q809, 810	Transistor, NPN	TR01062-7	2.45
Q811, 812	Transistor, NPN	TR01056-5	1.90
Q813, 814, 822	Transistor, NPN	TR01065	1.00
Q815, 816	Transistor, PNP	TR02063-1	.90
Q817, 818	Transistor, NPN Darlington	TR01064-9	8.75
Q819, 820	Transistor, PNP Darlington	TR02064-9	11.15
Q821	Transistor, PNP	TR02065	1.05
R801, 802, 813, 814	56K	RF25DC563J	.30
R803, 804, 825, 826	1.5K	RF25DC152J	.30
R805, 806	12	RF25DC120J	.30
R807, 815, 816, 823, 824	470	RF25DC471J	.30
R808	Composition, 33, 10%, ½W	RC20BF330K	.30
R809, 810	22K	RF25DC223J	.30
R811, 812	270K	RF25DC274J	.30
R817, 818, 835, 836	Composition, 1K, ½W	RC20BF102J	.30
R819, 820, 859, 860	Composition, 1.2K, ½W	RC20BF122J	.30
R821, 822	2.2K	RF25DC222J	.30
R827, 828	Variable, 1K, 30%	R50B150-20-2	.65
R829, 830	270	RF25DC271J	.30
R831, 832, 833, 834	8.2K	RF25DC822J	.30
R837, 838, 843, 844	120	RF25DC121J	.30
R839, 840, 841, 842	150	RF25DC151J	.30
R845, 846, 847, 848	Wirewound, 0.39, 5W	RW5WR39J	.50
R849, 850	Wirewound, 2, 2W	RW200W020J	.60
R851, 852	Composition, 10, 10%, ½W	RC20BF100K	.30
R853	1.8K	RF25DC182J	.30
R854	Composition, 22K, 10%, ½W	RC20BF223K	.30
R855, 856	10K	RF25DC103J	.30
R857	100K	RF25DC104J	.30
R858	220K	RF25DC224J	.30
R861	47K	RF25DC473J	.30
--	Heat Sink, Q809, 810	A50B842-5	.50
--	Insulator, Mica Q811, 812	E20413-4	.25
--	Insulator, Mica Q817, 818, 819, 820	E20413-5	.30
--	Socket, Transistor Q817, 818, 819, 820	ES20422	.45

Except as noted, resistors are Deposited Film, 5%, ¼W. K=Kilohm



CAUTION: When amplifiers are switched for 2-channel operation, inspect load connections carefully before testing or troubleshooting. Front-channel amplifier loads must be 'floating' (ungrounded). If any of the front-channel speakers COM terminals are grounded through common load returns, or through test equipment grounds connected to the load, the output of each series-connected rear amplifier will be short-circuited. This may trigger the auto shutdown circuit. The circuit can be reset by momentarily jumping pin AA (B+) to pin 99.

SERVICE NOTE: A defective amplifier may shut down prematurely and prevent normal troubleshooting methods from determining the amplifier fault. The auto shutdown circuit may be temporarily defeated by connecting a jumper between pin AA (B+) and pin 99.

CENTER VOLTAGE TEST

Set SPEAKERS switch to MAIN-4, slide MASTER VOLUME control to MIN. Warm-up unit about 10 minutes. Set line voltage to 120 VAC.
(1) Connect a 4-ohm load resistor between MAIN SPEAKERS FRONT LEFT and COM terminals.
(2) Connect a DC VTVM between the MAIN SPEAKERS FRONT LEFT terminal and chassis. Check for indication of 0 VDC (±100mVDC).
(3) Repeat for FRONT RIGHT, REAR LEFT, and REAR RIGHT speaker terminals.

IDLING CURRENT ADJUSTMENT

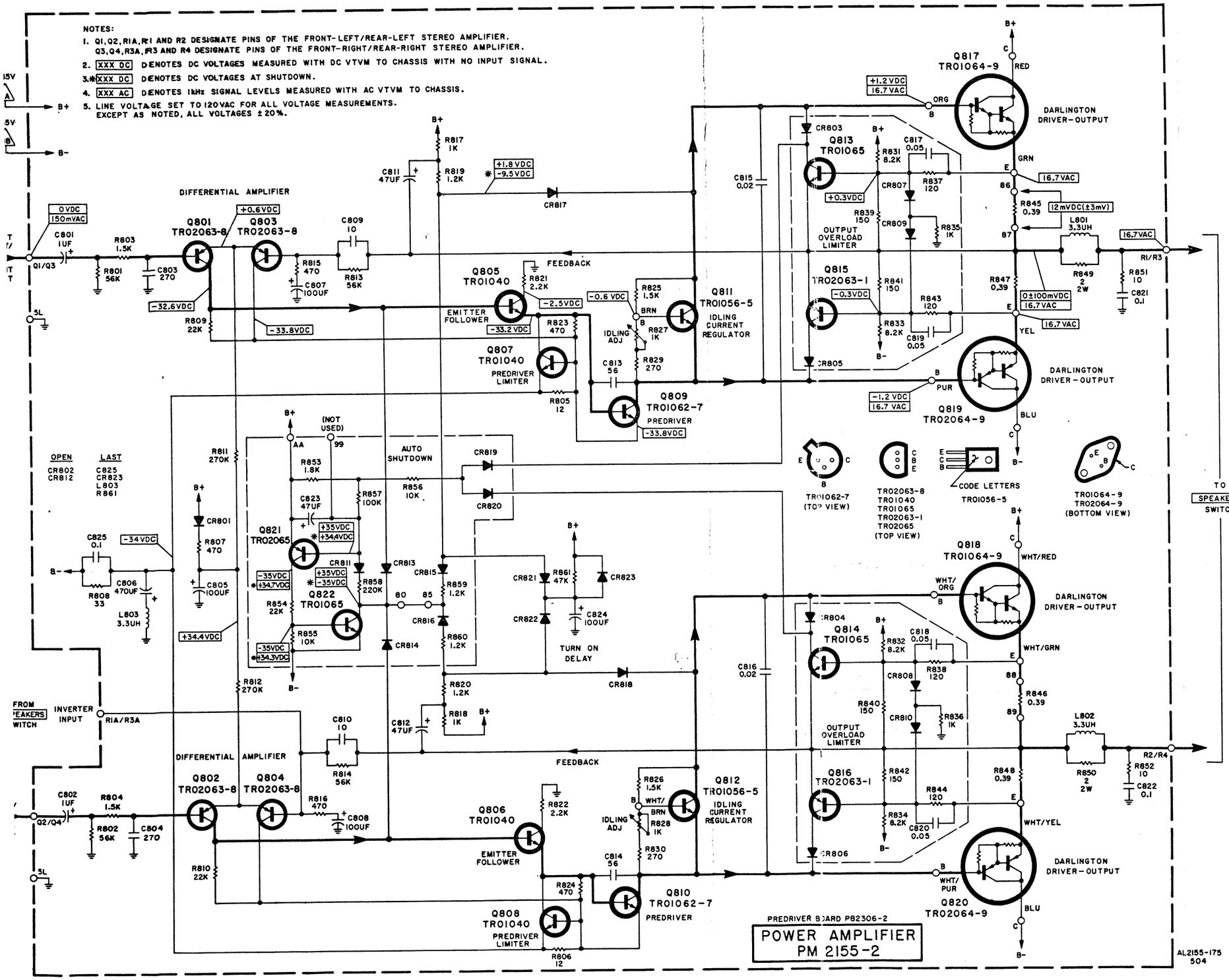
Set SPEAKERS switch to MAIN-4, slide MASTER VOLUME control to MIN. Warm-up unit about 10 minutes. Set line voltage to 120 VAC.

LEFT AMPLIFIERS

(1) Connect a 4-ohm load resistor between MAIN SPEAKERS FRONT LEFT and COM terminals. Connect DC VTVM between pins 86 and 87. See board layout illustration. Set IDLING ADJUST R825 for indication of 12mV (±3mV).
(2) Connect a 4-ohm load resistor between MAIN SPEAKERS REAR LEFT and COM terminals. Connect DC VTVM between pins 88 and 89. Set IDLING ADJUST R826 for indication of 12mV (±3mV).

RIGHT AMPLIFIERS

Repeat steps (1) and (2) for FRONT RIGHT and REAR RIGHT channels.



CIRCUIT DESCRIPTION

This discussion is limited to one amplifier channel. The other channel of the same module operates identically.

TURN-ON DELAY

Forward biasing of driver-output transistors Q817 and Q819 is momentarily delayed to eliminate audible turn-on transients generated by the input differential amplifier. When the receiver is turned on, C824 begins to charge through R817, R819, and CR821. When the voltage at the anode of CR817 rises to +1.8V, CR817, Q817, and Q819 become forward biased. (Output bias current flows through R817, R819, CR817, Q817, R845, R847, Q819, Q809, R805, and R808). CR821 becomes back-biased as C824 charges to a maximum of +35V through R861. After CR821 back-biases, the turn-on delay circuit has no effect on amplifier operation. When the receiver is turned off, CR823 rapidly discharges C824.

IDLING CURRENT REGULATOR

Transistor Q811 is adjusted to a fixed DC conduction by R827, maintaining a constant DC voltage between the basis of Q817 and Q819. This voltage determines the idling current through Q817, R845, R847, and Q819. The low internal impedance of Q811 has negligible effect on the AC drive fed to Q817. Capacitor C811 is connected to the output and boot-straps the bias circuit to provide extra drive to Q817 on positive swings.

OUTPUT OVERLOAD LIMITER

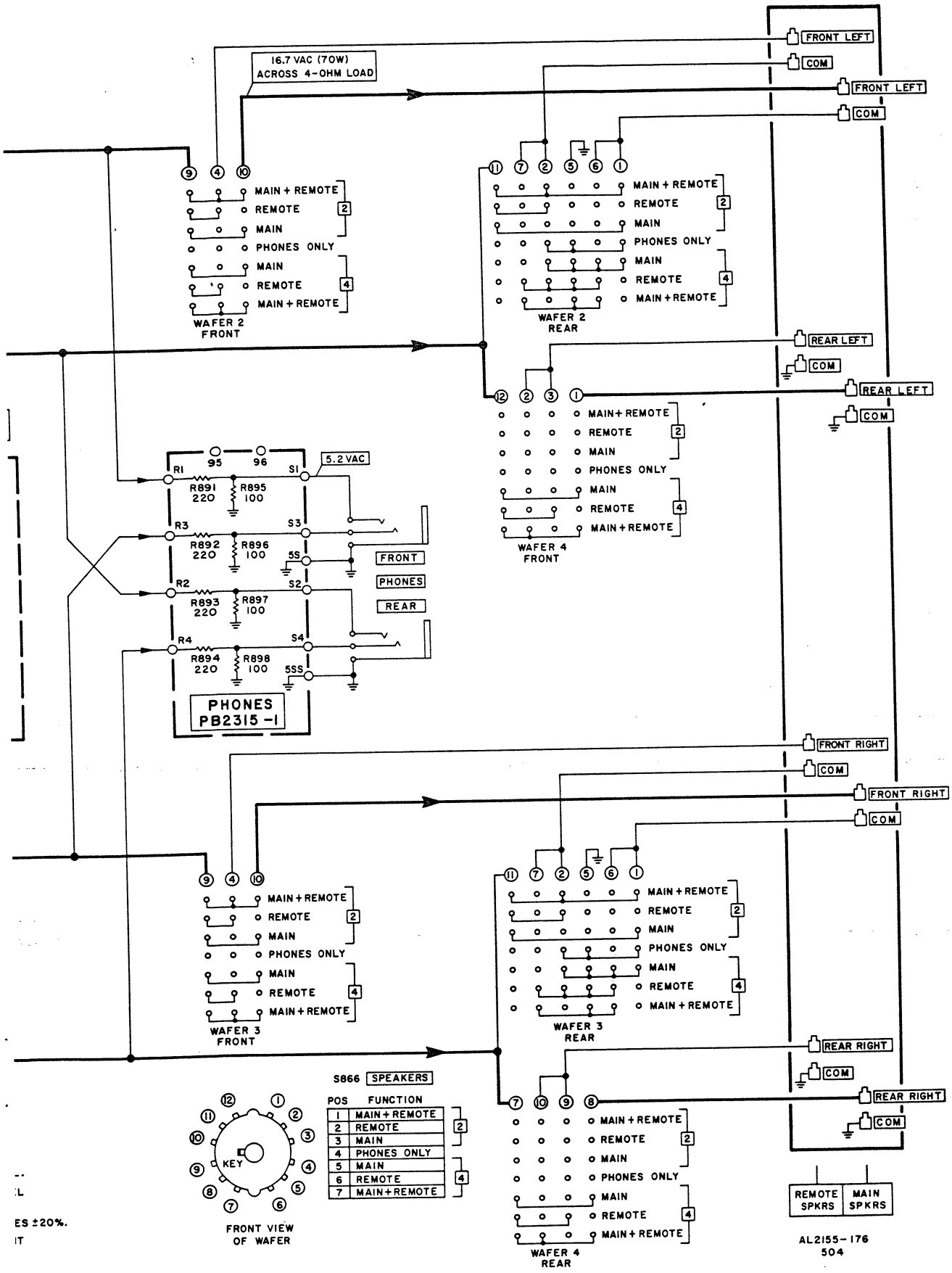
When load demands are excessive, Q813 shunts AC drive from the base of Q817. During normal operation, Q813 is biased below the conduction point. Network R837/R839 functions primarily to sense current through Q817. The primary function of divider R831/R839 is to sense voltage across Q817. Simultaneous voltage and current sensing, permits Q813 to restrict the operation of Q817 to the safe operating area. Similarly, Q815 restricts operation of Q819 to the safe operating area. C817 and C819 suppress oscillation of Q813 and Q815 at the limiting threshold. Under output short-circuit conditions, CR803 protects the collector-to-base junction of Q813 from negative bias during negative signal swings. Similarly, CR805 protects the collector-to-base junction of Q815 on positive signal swings.

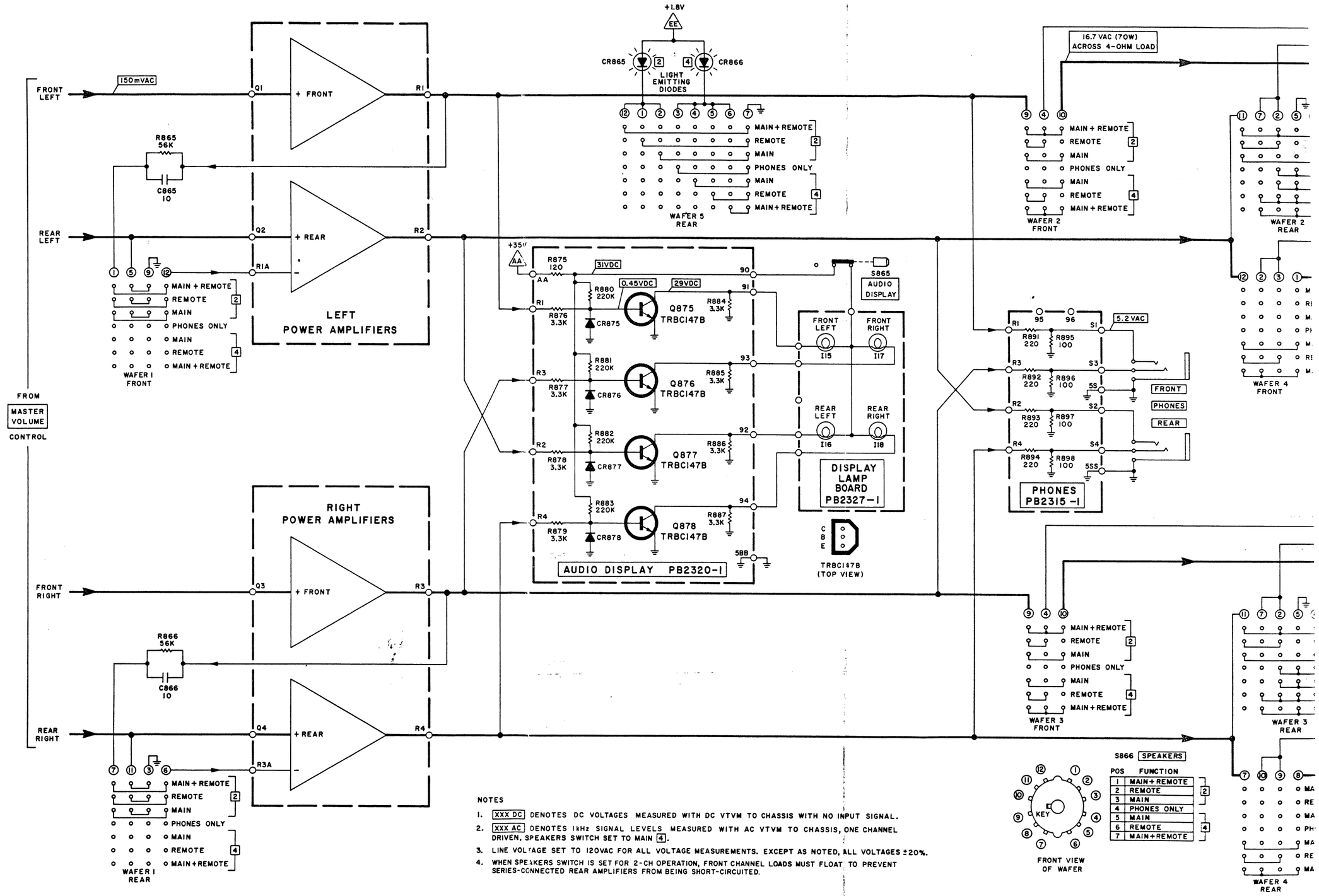
PREDRIVER LIMITER

Up to moderate overloads, Q807 remains shut off and has no effect on circuit operation. Under very high overload conditions; the voltage across R805 forward biases Q807, and signal is shunted from the base of Q809, protecting it from excessive current.

AUTO SHUTDOWN

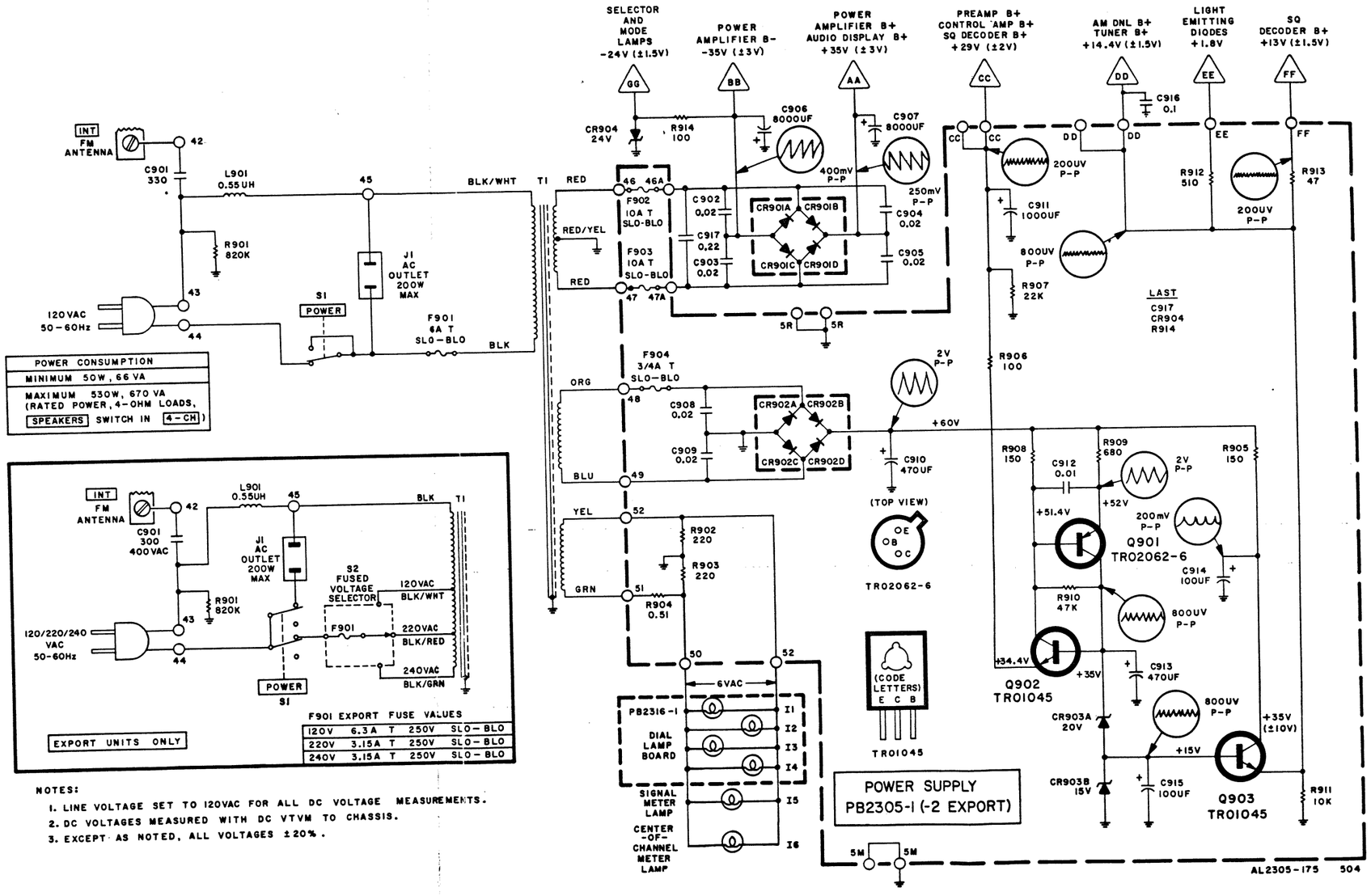
This circuit has no effect on the amplifier during normal operation. When the amplifier is overloaded, Q813 conducts on positive swings and current flows from B+ (pin AA) through R853, R856, and CR819. The voltage drop across R853 is applied to C823 through R857. The duty-cycle of Q813 determines the charge and discharge rate of C823. For the auto shutdown circuit to operate, C823 must charge to approximately 0.6V which forward biases Q821 and connects divider R854/R855 between the B+ and B- supplies. The voltage drop across R855 forward biases Q822 which forces Q821 and Q822 to saturate and latch. This condition causes CR813 and CR815 to forward bias and shut off Q805, Q817, and Q819, thereby disabling the amplifier. Whenever either channel causes the auto shutdown circuit to latch, both amplifiers are shut down. The customer must turn off the receiver for 30 seconds or more to permit C823 to discharge sufficiently for Q821 and Q822 to unlatch.


16.7 VAC (70W) ACROSS 4-OHM LOAD
FRONT LEFT
COM
FRONT LEFT
COM
MAIN + REMOTE
REMOTE
MAIN
PHONES ONLY
MAIN
REMOTE
MAIN + REMOTE
WAFER 2 FRONT
WAFER 2 REAR
REAR LEFT
COM
REAR LEFT
COM
WAFER 4 FRONT
5.2 VAC
R891 220
R895 100
R892 220
R896 100
R893 220
R897 100
R894 220
R898 100
FRONT
PHONES
REAR
PHONES PB2315-1
FRONT RIGHT
COM
FRONT RIGHT
COM
WAFER 3 FRONT
WAFER 3 REAR
REAR RIGHT
COM
REAR RIGHT
COM
WAFER 4 REAR
S866 SPEAKERS
POS FUNCTION
1 MAIN + REMOTE
2 REMOTE
3 MAIN
4 PHONES ONLY
5 MAIN
6 REMOTE
7 MAIN + REMOTE
KEY
FRONT VIEW OF WAFER
REMOTE SPKRS
MAIN SPKRS
AL2155-176
504



NOTES

1. [XXX DC] DENOTES DC VOLTAGES MEASURED WITH DC VTVM TO CHASSIS WITH NO INPUT SIGNAL.
2. [XXX AC] DENOTES 1kHz SIGNAL LEVELS MEASURED WITH AC VTVM TO CHASSIS, ONE CHANNEL DRIVEN, SPEAKERS SWITCH SET TO MAIN [4].
3. LINE VOLTAGE SET TO 120VAC FOR ALL VOLTAGE MEASUREMENTS. EXCEPT AS NOTED, ALL VOLTAGES ±20%.
4. WHEN SPEAKERS SWITCH IS SET FOR 2-CH OPERATION, FRONT CHANNEL LOADS MUST FLOAT TO PREVENT SERIES-CONNECTED REAR AMPLIFIERS FROM BEING SHORT-CIRCUITED.



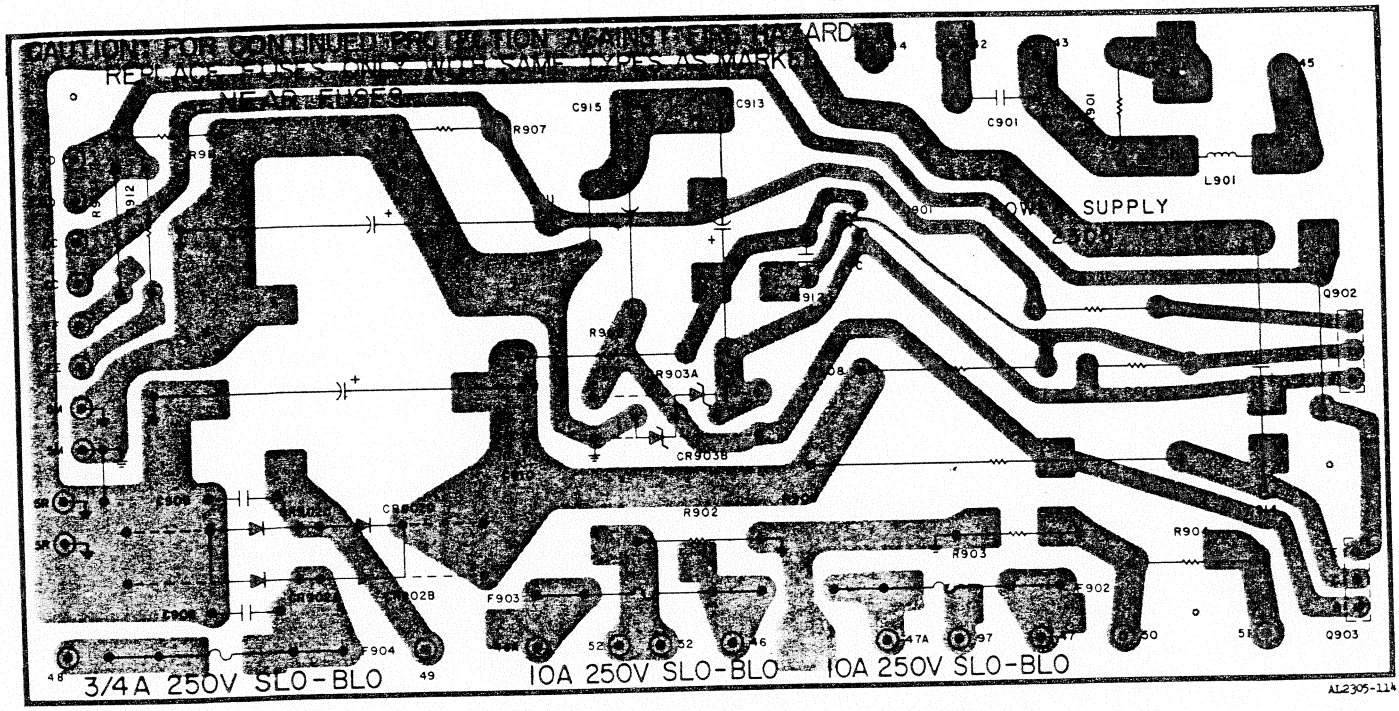
POWER CONSUMPTION
MINIMUM 50W, 66 VA
MAXIMUM 530W, 670 VA (RATED POWER, 4-OHM LOADS, SPEAKERS SWITCH IN 4-CH)

F901 EXPORT FUSE VALUES

120V	6.3A T	250V	SLO-BLO
220V	3.15A T	250V	SLO-BLO
240V	3.15A T	250V	SLO-BLO

NOTES:

1. LINE VOLTAGE SET TO 120VAC FOR ALL DC VOLTAGE MEASUREMENTS.
2. DC VOLTAGES MEASURED WITH DC VTVM TO CHASSIS.
3. EXCEPT AS NOTED, ALL VOLTAGES ±20%.



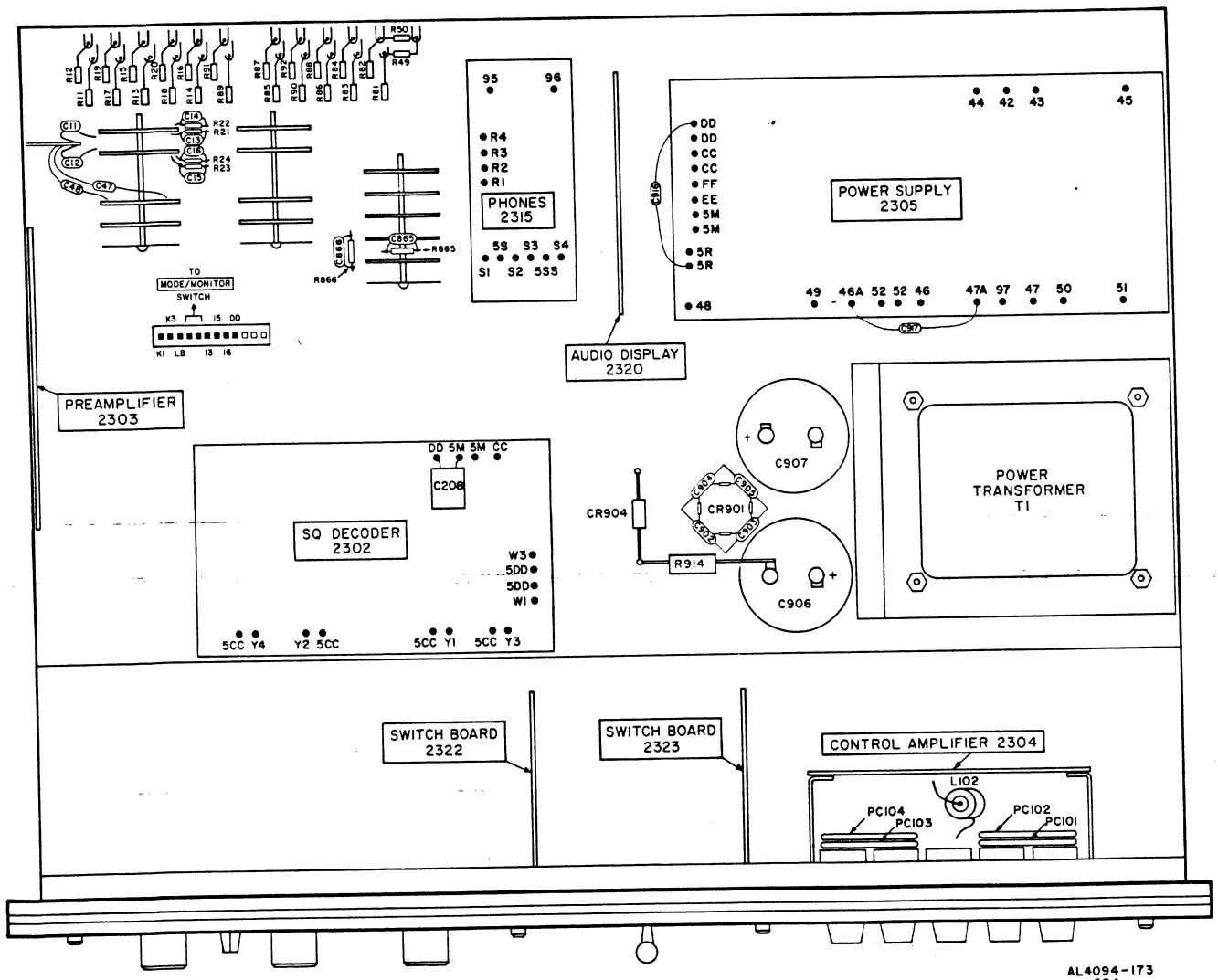
Symbol	Description	Part Number	Sug. Ret.
C901	Ceramic, 330pF, +80-20%	CK22352-3	.40
* C901	Ceramic, 300pF, 400VAC	C51164-1	.90
C902, 903, 904, 905, 908, 909	Ceramic, 0.02UF, 20%, 500V	CK22359-3	.45
*C906, 907	Electrolytic, 8000UF, 50V	CE22357-2	7.10
C910	Electrolytic, 470UF, 100V	CE22343-44	.90
C911	Electrolytic, 1000UF, 50V	CE22343-36	1.25
C912	Ceramic, 0.01UF, +80-20%, 100V	C50B570-1	.40
C913	Electrolytic, 470UF, 50V	CE22343-33	.95
C914	Electrolytic, 100UF, 100V	CE22343-43	.75
C915	Electrolytic, 100UF, 25V	CE22343-26	.45
C916	Mylar, 0.1UF, 20%, 250V	C50B575-1	.50
C917	Mylar, 0.22UF, 10%, 250V	C50B575-2	.60
CR901A, B, C, D	Bridge Rectifier, 25A, 200V	BR51401-2	8.00
CR902A, B, C, D	Bridge Rectifier, 1.5A, 200V	BR51400-1	1.45
CR903A	Zener, 20V, 3%, 1W	TR14002-13	1.25
CR903B	Zener, 15V, 3%, 1W	TR14002-12	1.25
CR904	Zener, 24V, 5%, 3W	TR14001-1	1.05
F901	Fuse, 6A, 125V, Slo-Blo	FL51313-25	.70
* F901	Fuse, 6.3A, 250V, Slo-Blo	F51B247-24	.60
* F901	Fuse, 3.15A, 250V, Slo-Blo	F51B247-20	.60
F902, 903	Fuse, 10A, 250V, Slo-Blo	FL51313-22	.85
F904	Fuse, 3/4A, 250V, Slo-Blo	FL51313-7	.85
I1, 2, 3, 4	Dial Lamp	LM21434	1.00
I5, 6	Lamp, Meter-Signal, Center-of-Ch	AS21410-6	.75

Symbol	Description	Part Number	Sug. Ret.
J1	AC Outlet	JK20665	.60
L901	Choke, 0.55UH	LC21818	.45
Q901	Transistor, PNP	TR02062-6	3.20
Q902, 903	Transistor, NPN	TR01045	3.05
R901	Composition, 820K, 10%	RC20BF824K	.30
R902, 903	Deposited Film, 220	R50DC221J	.35
R904	Wirewound, 0.51, 2W	RW200WR51J	.60
R905	Wirewound, 150, 10W	RP10W151J	.50
R906	Wirewound, 100, 2W	RW200W101J	.45
R907	Deposited Film, 22K	R50DC223J	.30
R908	Wirewound, 150, 5W	RP5W151J	.50
R909	Deposited Film, 680	R50DC681J	.35
R910	Deposited Film, 47K	R50DC473J	.30
R911	Deposited Film, 10K	R50DC103J	.30
R912	Composition, 510	RC20BF511J	.30
R913	Composition, 47	RC20BF470J	.30
R914	Wirewound, 100, 3W	RW3W101J	.50
S1	Switch, POWER	SP50200-65	2.95
*S1	Switch, POWER	SP50200-64	2.55
*S2	Switch, Fused Voltage Selector	SR51304-1	1.90
T1	Transformer, Power	TD4094-115	36.70
*T1	Transformer, Power	TE4094-215	41.15
--	Line Cord	W50023-1	1.20
--	*Line Cord (3-Conductor)	WR20678	3.20
--	Mounting Pad, Q901	A50618	.40
--	Heat Sink, Q901	A50B842-5	.50
--	Insulator, Q902, Q903	E20413-3	.25
--	Fuse Holder	EA51408	.95

*Used in Export Units

Except as noted, resistors are 5%, ½W. K=Kilohm

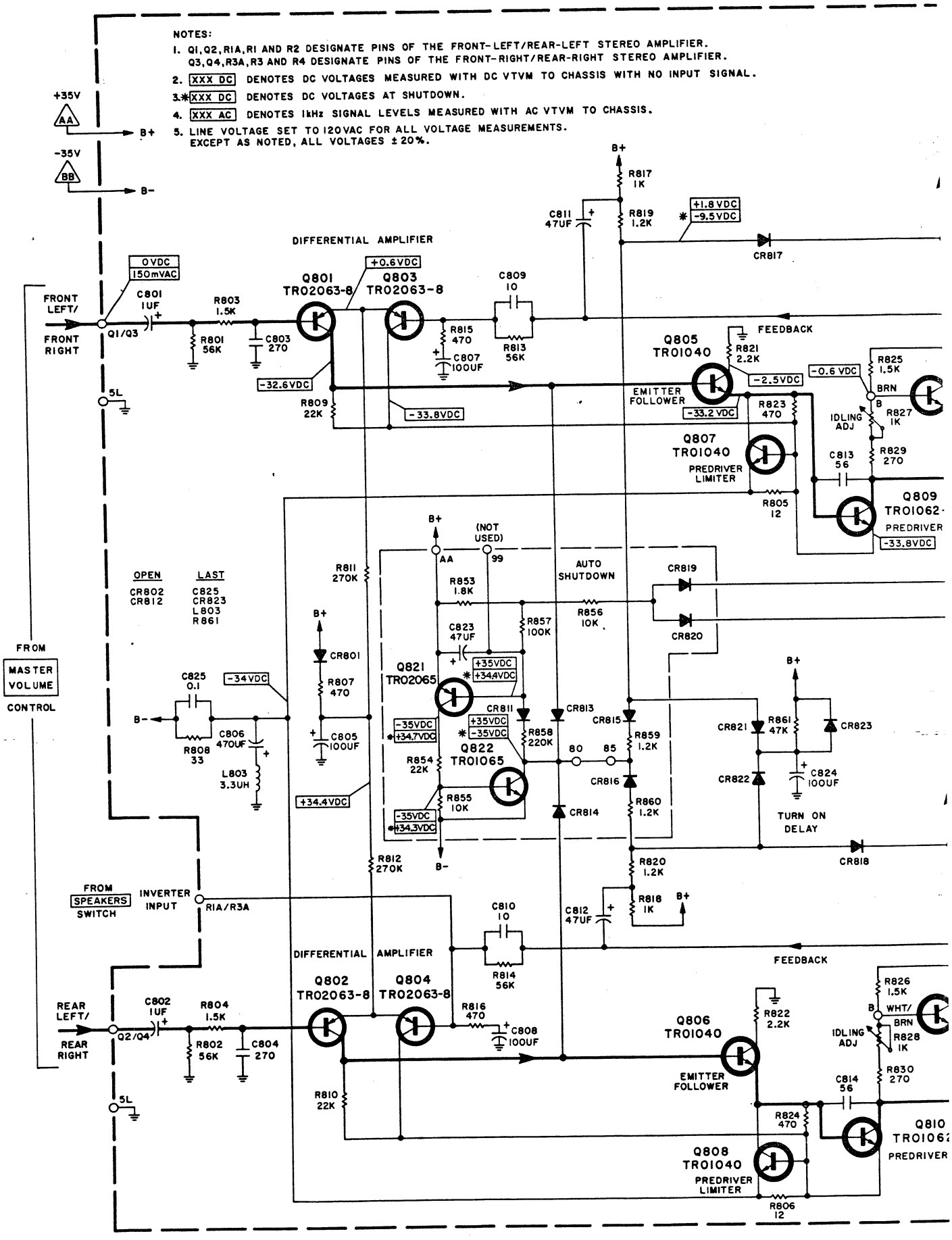
CHASSIS LAYOUT



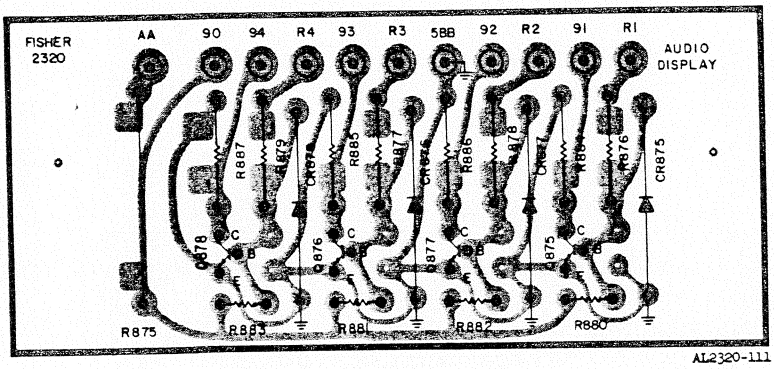
CHASSIS LAYOUT-BOTTOM

AL4094-173
504

POWER AMPLIFIER 2155-2

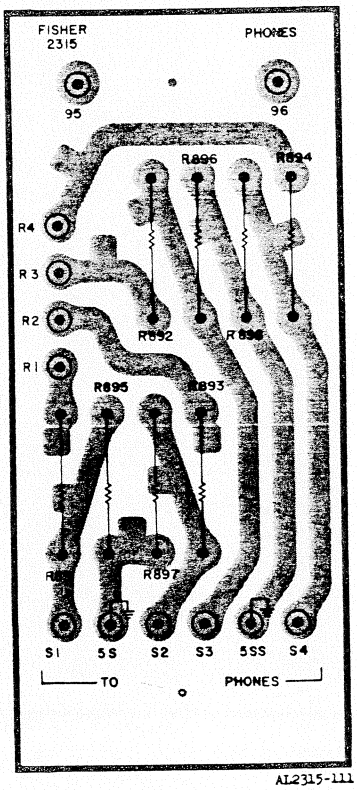


AUDIO DISPLAY 2320-1/PHONES 2315-1



Symbol	Description	Part Number	Sug. Ret.
C865, 866	Ceramic, 10pF, 10%, 100V, NP0	CK22360-3	.30
CR865, 866	L.E.D. (with mounting clip and retainer)	TR19003	2.05
CR875, 876, 877, 878	Diode, Silicon	TR13006-2	.35
I15, 16, 17, 18	Lamp, Sub-Miniature	LM21421-4	.70
Q875, 876, 877, 878	Transistor, NPN (BC147B)	TRBC147B	1.00
R865, 866	56K	RF25DC563J	.30
R875	Wirewound, 120, 5W	RW5W121J	.50
R876, 877, 878, 879	3.3K	RF25DC332J	.30
R880, 881, 882, 883	220K	RF25DC224J	.30
R884, 885, 886, 887	Composition, 3.3K, ½W	RC20BF332J	.30
R891, 892, 893, 894	Wirewound, 220, 2W	RW200W221J	.45
R895, 896, 897, 898	100, ½W	R50DC101J	.30
S865	Switch, AUDIO DISPLAY	SP50200-62	.95
S866	Switch, SPEAKERS	SR4094-151	7.95
--	Jack, PHONES-FRONT, REAR	JK20627-5	1.10

Except as noted, resistors are Deposited Film, 5%, ¼W. K=Kilohm



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